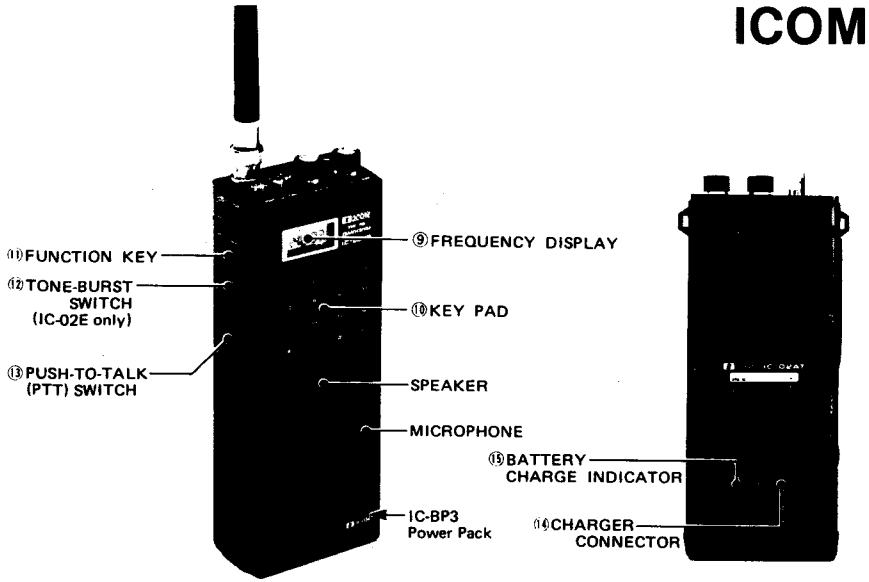
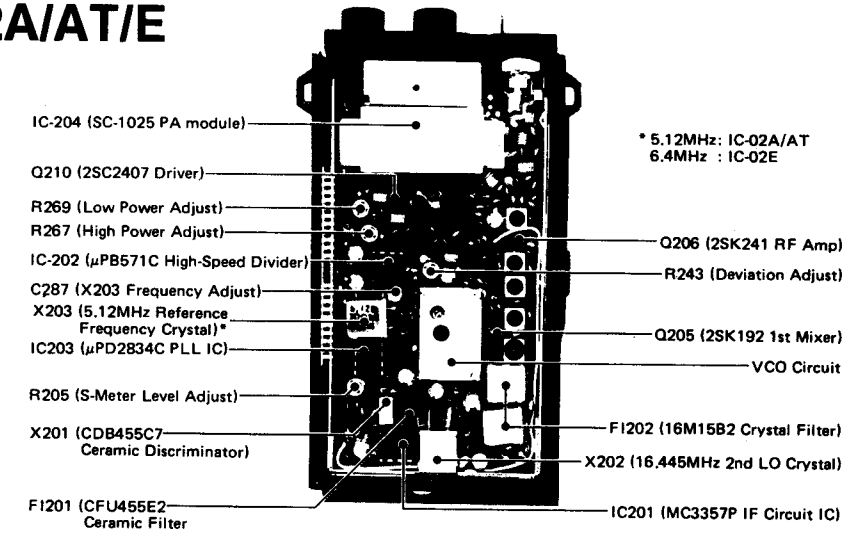
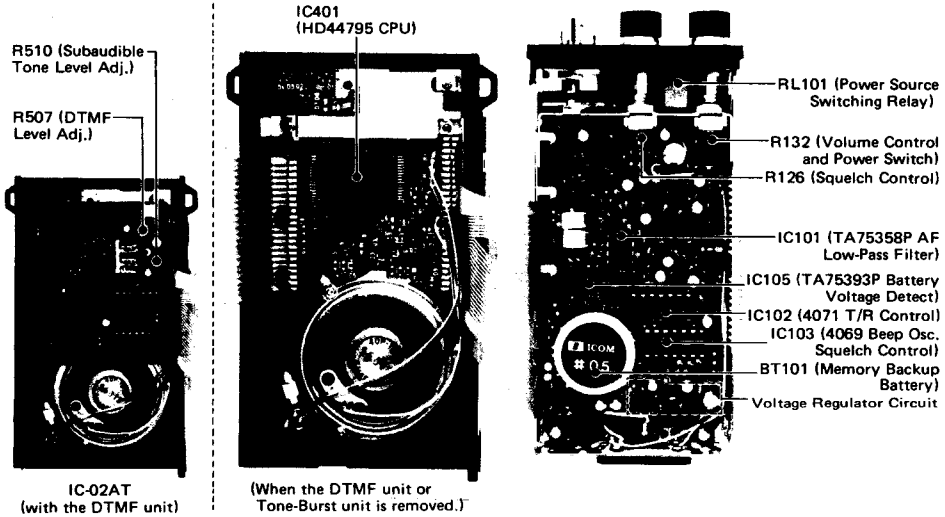
ICOM IC-02A/AT/E





VISTA INTERNA


R510 (Subaudible Tone Level Adj.)
R507 (DTMF Level Adj.)
IC401 (HD44795 CPU)
RL101 (Power Source Switching Relay)
R132 (Volume Control and Power Switch)
R126 (Squelch Control)
IC101 (TA75358P AF Low-Pass Filter)
IC105 (TA75393P Battery Voltage Detect)
IC102 (4071 T/R Control)
IC103 (4069 Beep Osc. Squelch Control)
BT101 (Memory Backup Battery)
Voltage Regulator Circuit

IC-02AT (with the DTMF unit)

(When the DTMF unit or Tone-Burst unit is removed.)

FUNZIONI DELLA TASTIERA

REGISTRAZIONE DELLE MEMORIE
1) premere CL
2) impostare la frequenza (vedi sopra)
3) impostare lo SHIFT (vedi sopra)
— tenendo premuto il tasto FUNC:
4) premere MW seguito dal numero della memoria

RICHIAMO MEMORIE
1) premere MR seguito dal numero della memoria richiesta

SCANSIONE MANUALE DELLE MEMORIE
1) richiamare una memoria qualsiasi
2) premere + per salire e — per scendere

SCANSIONE AUTOMATICA DELLE MEMORIE
1) premere MS

MEMORIE SPECIALI
M1 viene richiamata premendo CALL
M2-3-4-4-6 hanno tutte lo stesso SHIFT di M1
H7-8-9-0 possono avere SHIFT diversi da M1
M0 = inizio ricerca automatica delle frequenze
M9 = fine ricerca automatica delle frequenze

SCANSIONE MANUALE DELLE FREQUENZE
1) premere CL
2) premere + per salire e — per scendere

SCANSIONE AUTOMATICA DELLE FREQUENZE
1) premere CL
2) premere FUNC insieme a PS
(La ricerca parte dalla frequenza di MO fino a quella di H9 e viene influenzata da STEP)

CAMBIARE LO STEP
1) premere CL
— tenendo premuto il tasto FUNC:
2) premere STEP seguito da:
2 - per i passi da 12,5 kHz
4 - per i passi da 25 kHz

RICEVERE SULL'INGRESSO E TRASMETTERE SULL'USCITA DI UN PONTE
1) richiamare la memoria del ponte richiesto
2) premere CL
3) premere insieme FUNC e REVERSE

RICEZIONE CON FUNZIONE PRIORITÁRIA
1) impostare in M1 la frequenza PRIORITARIA
2) impostare sul display la frequenza OPERATIVA
3) tenendo premuto FUNC premere PRIO
(Il ricevitore riceve la frequenza OPERATIVA ed ogn 5 sec passerà su quella PRIORITARIA)

METTERE O TOGLIERE IL BEEP
1) premere FUNC insieme a BEEP

BLOCCARE O SBLOCCARE I COMANDI
1) premere FUNC insieme a LOCK

PRONTUARIO PER L'USO DELL'ICOM IC-02 E

IMPOSTARE UNA FREQUENZA
1) premere CL
2) introdurre le ultime cifre della frequenza

IMPOSTARE LO SHIFT
— tenendo premuto il tasto FUNC:
1) premere SHIFT
2) premere — oppure +
3) introdurre lo shift in MHz (—600 = —060)

CARATTERISTICHE DEI MODELLI IC-02

GENERAL

Number of semiconductors	Transistors	42 (02AT: 48 02E: 43)	
	FETs	3	
	ICs	10 (02AT: 13, 02E: 11)	
	Diodes	40 (02AT: 46)	
Frequency coverage	02A/AT:	144MHz ~ 148MHz	
	02E:	144MHz ~ 146MHz	
	(Some versions cover 140MHz ~ 149.995MHz without guaranteed specifications.)		
Frequency readout	6 digit 5kHz readout, LCD		
Frequency resolution	02A/AT:	5kHz steps (other steps such as 10kHz, 15kHz, 20kHz and 25kHz are programmable and available by pushing the UP/DOWN buttons)	
	02E:	12.5kHz steps (25kHz steps are programmable)	
Frequency control	Digital PLL synthesizer with key input		
Frequency stability	Within 0.002% in range of −10°C ~ +60°C		
Memory channels	10 Channels		
Scanning	Programmed Scan and Memory Channel Scan available		
Usable temperature	−10°C ~ +60°C		
Antenna impedance	50 ohms unbalanced		
Power supply requirement	DC 8.4V with IC-BP3 attendant power pack		
	DC 5.5V ~ 16V negative ground is acceptable.		
Current drain at 8.4V	Transmitting:	HIGH (3W)	Approx. 1.05A
		LOW (0.5W)	Approx. 0.45A
	Receiving:	At max audio output	Approx. 140mA
		Squelched	Approx. 35mA
Dimensions	116.5mm(H) x 65mm(W) x 35mm(D) without power pack.		
	IC-BP3 attendant power pack: 49mm(H) x 65mm(W) x 35mm(D)		
Weight	515g (IC-02A: 495g) including IC-BP3 power pack and flexible antenna		

TRANSMITTER

Output power	HIGH: 3W at 8.4V (5W at 13.2V)
	LOW: 0.5W at 8.4V ~ 13.2V
Emission mode	F3E 16K0 (16F3)
Modulation system	Variable reactance frequency modulation
Max. frequency deviation	±5kHz
Spurious emission	More than 60dB below carrier
Microphone	Built-in electret condenser microphone
	Optional Speaker-microphone (IC-HM9) and Headset (HS-10) can be used.
Operating mode	Simplex
	Duplex (Any in-band frequency separation programmable.)

RECEIVER

Receiving system	Double-conversion superheterodyne
Modulation acceptance	F3E 16K0 (16F3)
Intermediate frequencies	1st: 16.9MHz 2nd: 455kHz
Sensitivity	Less than 0.25μV for 12dB SINAD
	Less than 0.3μV for 20dB noise quieting
Squelch sensitivity	Less than 0.1μV
Spurious response rejection ratio	More than 60dB
Selectivity	More than ±7.5kHz at −6dB point
	Less than ±15kHz at −60dB point
Audio output power	*More than 500mW (at 8 ohms, 10% distortion)*
Audio output impedance	8 ohms

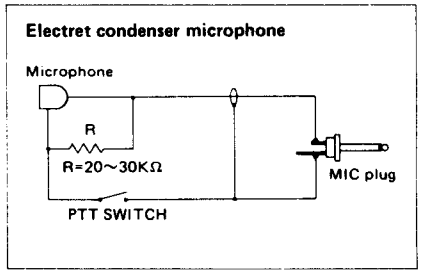
(3) EXTERNAL POWER SOURCE

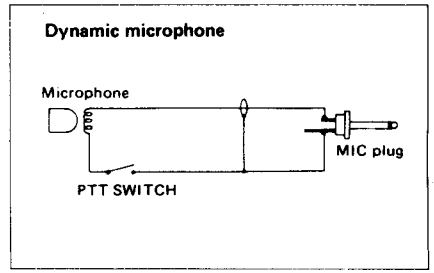
For use at home or in a car, use an external power source which assures you of stable communication without concern for battery consumption.

1. Use either a 13.8V DC regulated power supply or car battery rated at over 1.5A current capability.
2. Correctly connect the external supply as shown in the figure. If polarity is reversed, source power is cut off by the protection circuit and the unit will not operate.
3. When the transceiver is not used for a prolonged period, the unit is operated for extended periods by external power only, or when the batteries are exhausted, remove the batteries to protect the unit from possible damage by battery leakage (when using IC-BP4 with alkaline batteries).

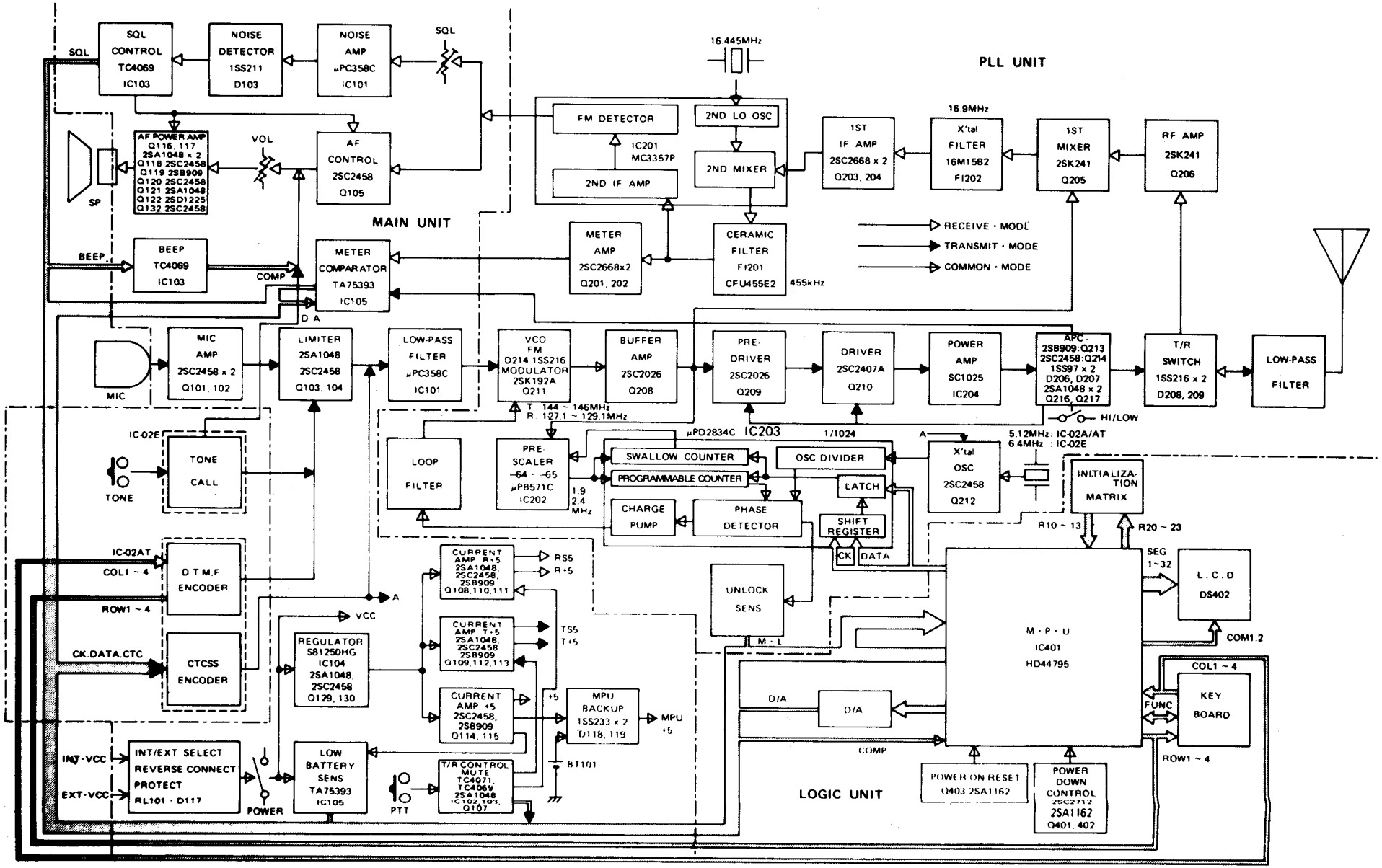
4-2 EXTERNAL ANTENNA

1. Select a high performance antenna (a multi-element beam or gain antenna) and set it up in the highest possible position.
2. Use a 50 ohm antenna and coaxial cable with BNC plug.

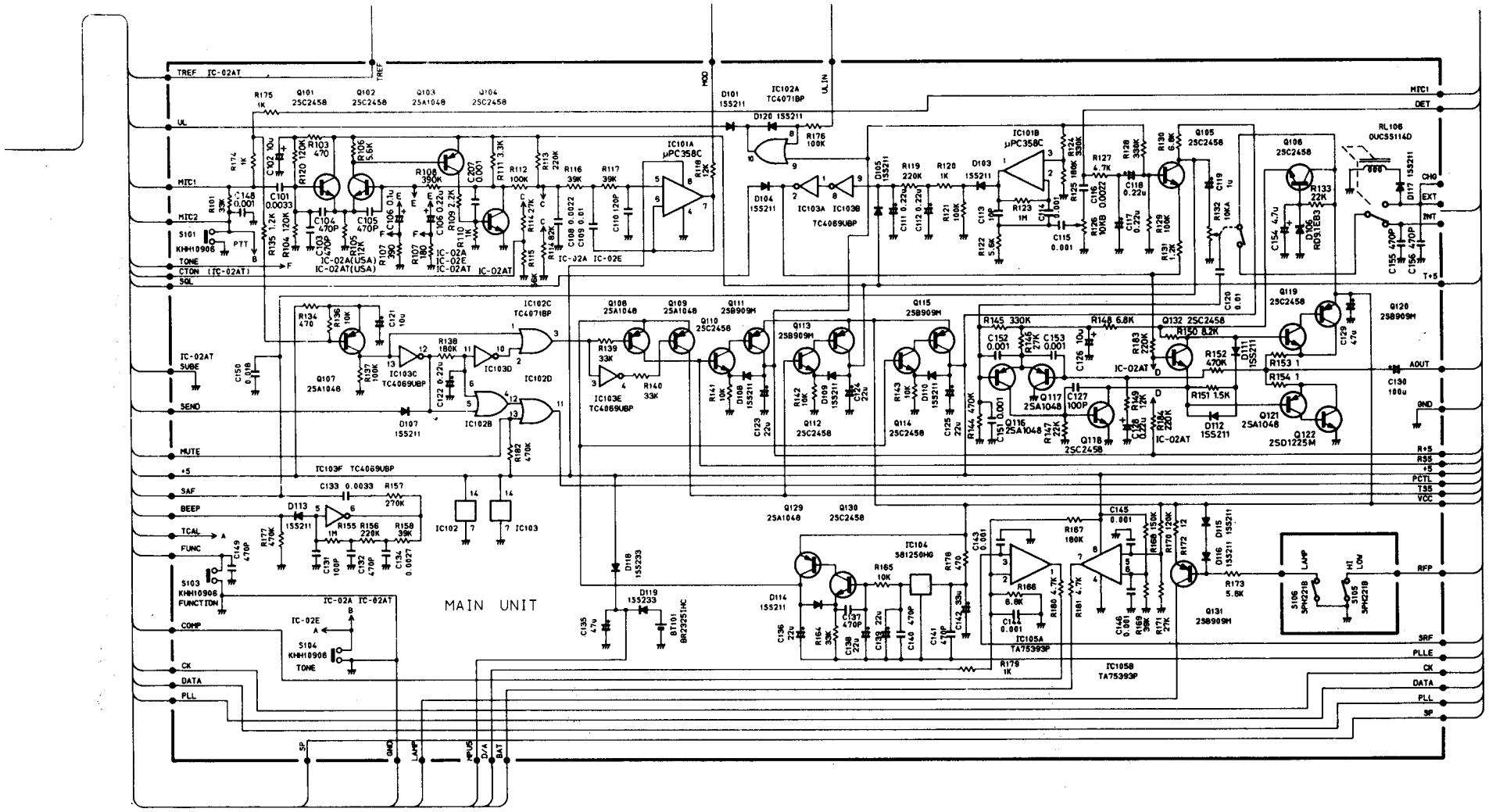




SCHEMA A BLOCCHI



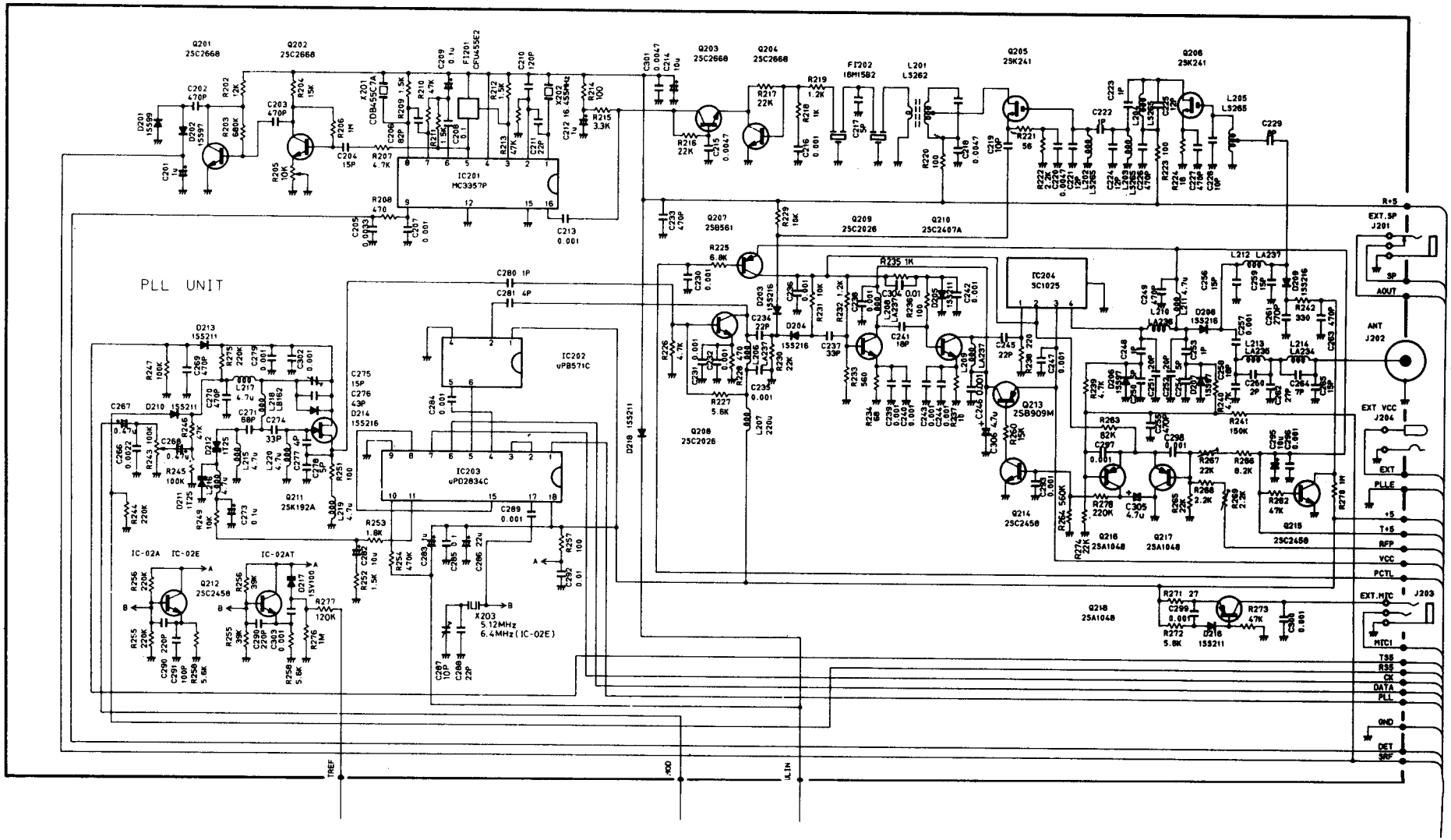
SCHEMA ELETTRICO DELLA SEZIONE MAIN UNIT



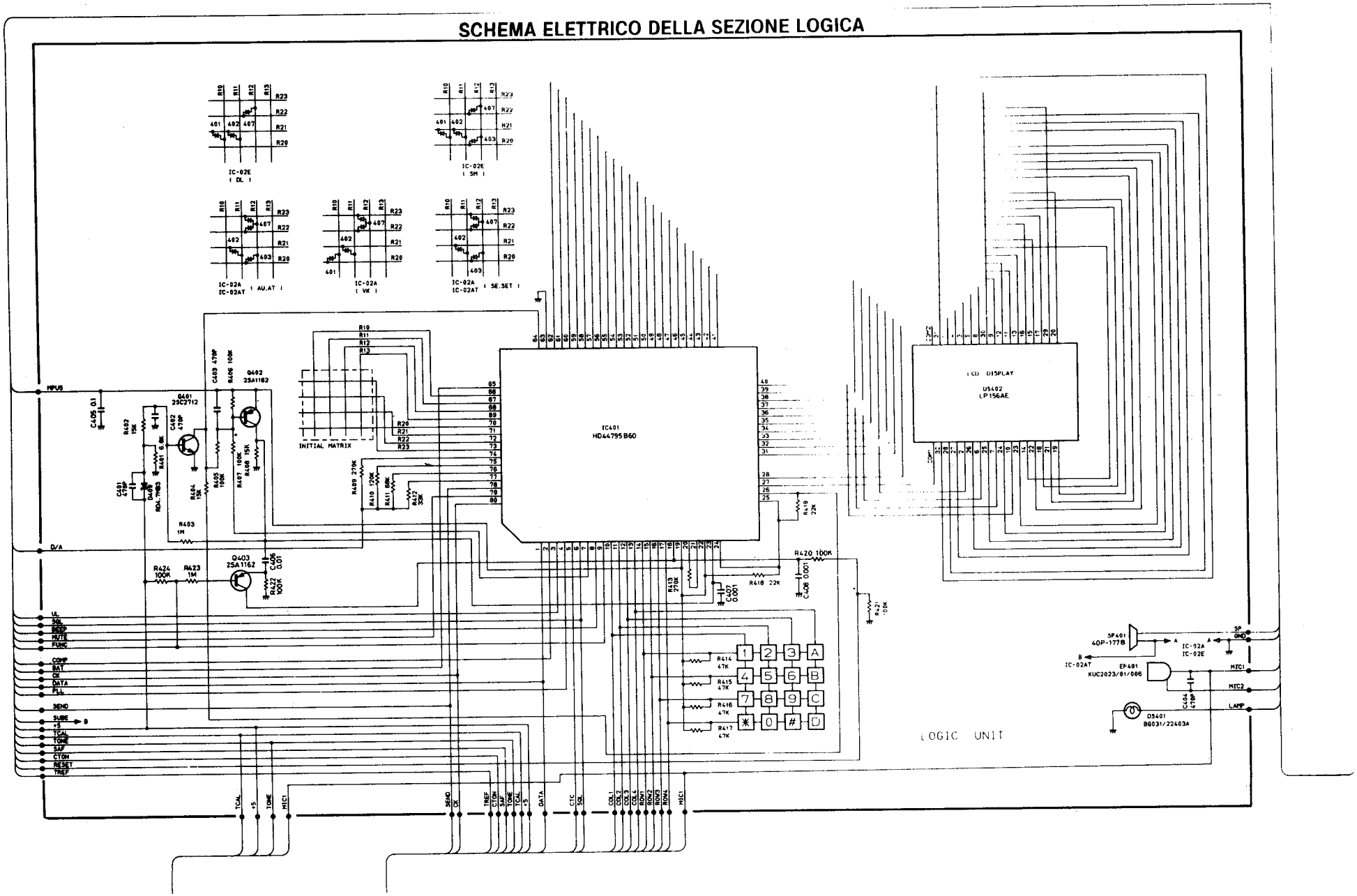
ICOM ICOM INCORPORATED

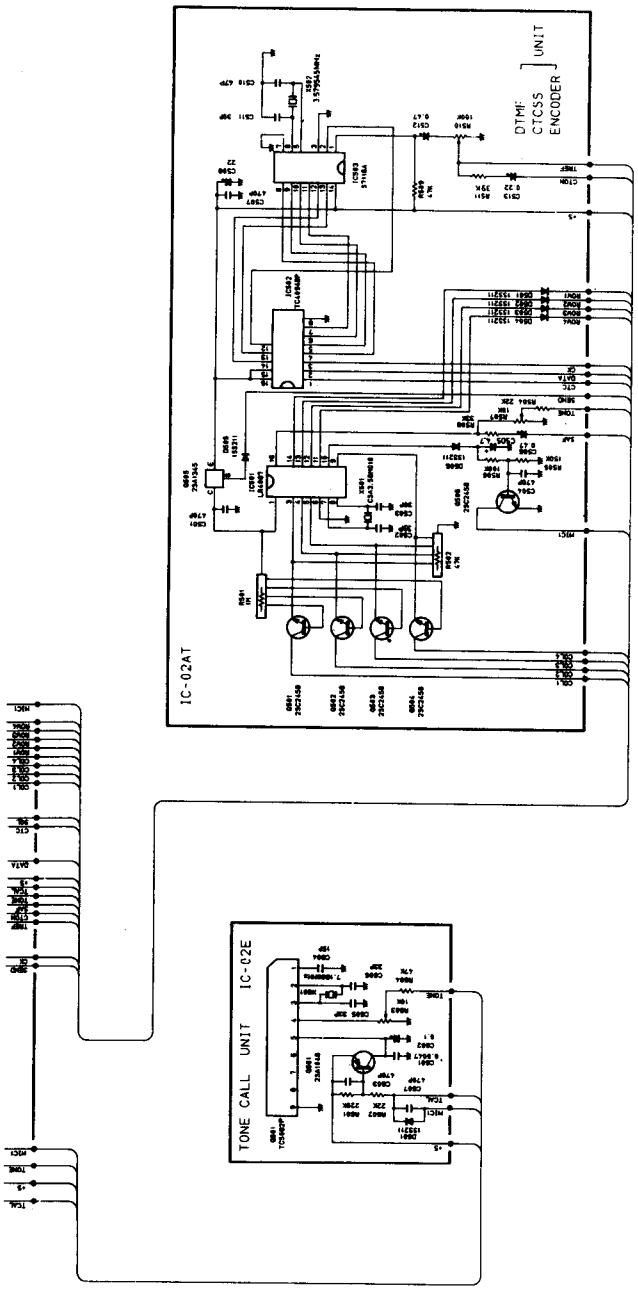
Some components subject to change for an improvement without notice.

SCHEMA ELETTRICO DELLA SEZIONE PLL



SCHEMA ELETTRICO DELLA SEZIONE LOGICA





ICOM

ICOM HANDHELD TRANSCEIVER ACCESSORIES

Thank you for purchasing an ICOM handheld transceiver.

This brochure shows all accessories for ICOM IC-2A/AT/E, IC-3A/AT, IC-4A/AT/E, IC-02A/AT/E and IC-04A/AT/E handheld transceivers.

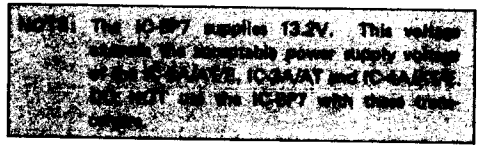
To fully enjoy the benefits of your high-performance transceiver with the following accessories, please read this brochure thoroughly prior to purchasing your accessories.

■ BATTERY PACKS

ICOM offers various battery packs to suit your needs. These battery packs can be easily charged by using an AC desk top charger, wall charger or car battery with the Cigarette Lighter cable.

Each battery pack has unique characteristics for output voltage, battery lifetime, size and suitable charger. Select the battery pack that best meets your requirements.

In addition, the standard batteries in the IC-BP4 may be replaced with the same size of Nickel Cadmium rechargeable batteries.



BATTERY PACK SPECIFICATIONS

	IC-BP2	IC-BP3	IC-BP4		IC-BP5	IC-BP7	IC-BP8
			Dry Battery	NiCd Battery			
Internal Cells (Capacity)	NiCd x 6 (425mAH)	NiCd x 7 (270mAH)	AA Size Alkaline x 6	AA Size NiCd x 6	NiCd x 9 (425mAH)	NiCd x 11 (425mAH)	NiCd x 7 (800mAH)
Voltage	7.2V	8.4V	9.0V	7.2V	10.8V	13.2V	8.4V
Suitable Charger	BC-35 BC-36	BC-35 BC-36 BC-25U/E BC-26E BC-27	–	BC-35 BC-36	BC-35 BC-36	BC-35 BC-36 BC-16U/E BC-17	BC-35 BC-36 BC-16U/E BC-17
	–	IC-CP1	–	–	–	IC-CP1	IC-CP1
Charging Period	1.5H: BC-35 BC-36	15H: Any Charger	–	15H: BC-35 BC-36	1.5H: BC-35 BC-36	1.5H: BC-35 BC-36 15H: BC-16U/E BC-17 IC-CP1	3H: BC-35 BC-36 15H: BC-16U/E BC-17 IC-CP1
Charging Current with BC-35 or BC-36	600mA	25mA	–	45mA	600mA	600mA	600mA
Ambient Temperature	+10°C~+40°C	0°C~+40°C	–	0°C~+45°C	+10°C~+40°C	+10°C~+40°C	+10°C~+40°C
Overcharge Protected	Yes	No	No	No	Yes	Yes	Yes
Battery Pack Height	39mm	39mm	49mm		60mm	80mm	80mm
Features	•For NORMAL power output •Small size •Rapid charging	•For NORMAL power output •Small size •Variety of chargers	•Regular dry batteries can be replaced with same AA size NiCd batteries.		•Long life •Rapid charging	•Long life •For HIGH power output •Rapid charging	•Very long life •Rapid charging

DUAL MODULUS PRE-SCALER

IC202 is a dual modulus pre-scaler, that divides the signals from 127MHz to 151MHz generated by the VCO by either 1/64 or 1/65.

IC203 is a C-MOS LSI for use PLL in a frequency synthesizer. It incorporates a swallow-counter of binary 6 bits, a programmable counter of binary 11 bits, a phase comparator, a charge pump and a frequency divider for the reference frequency.

The reference frequency is obtained by crystal oscillator Q212 with crystal unit X203, and is fed to pin 17 of IC203. It divides the frequency by 1/1024, the reference frequency becomes 5KHz and is fed to pin 8 of IC203.

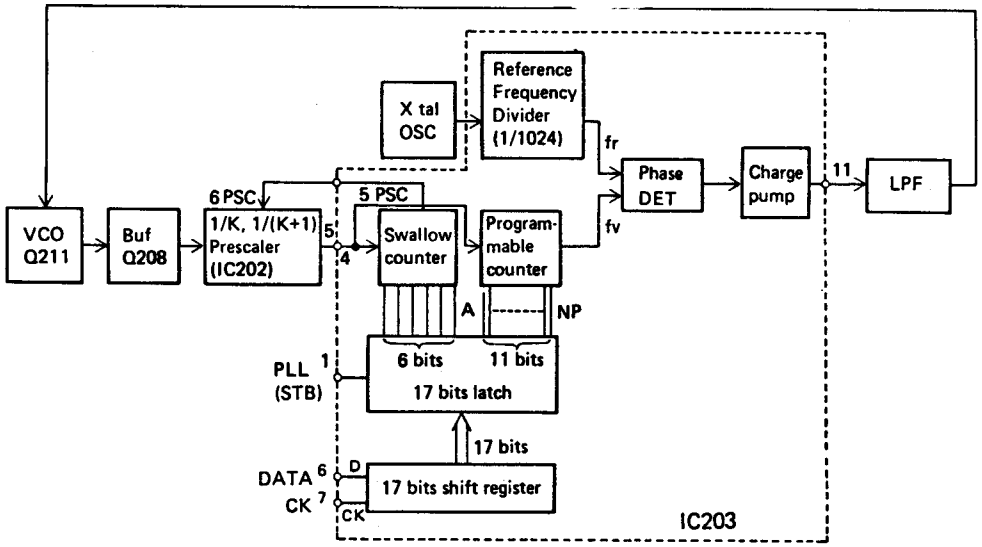
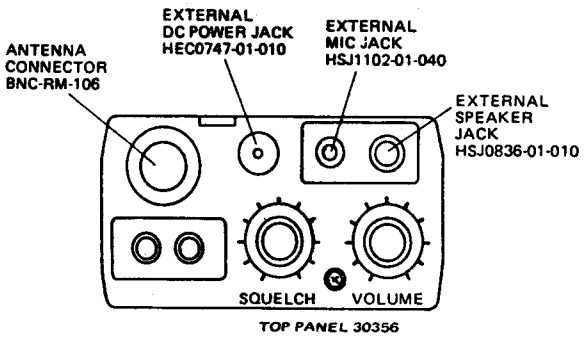
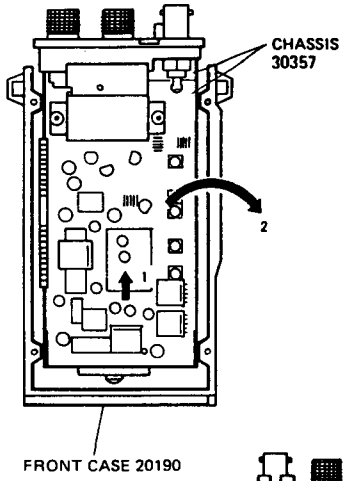
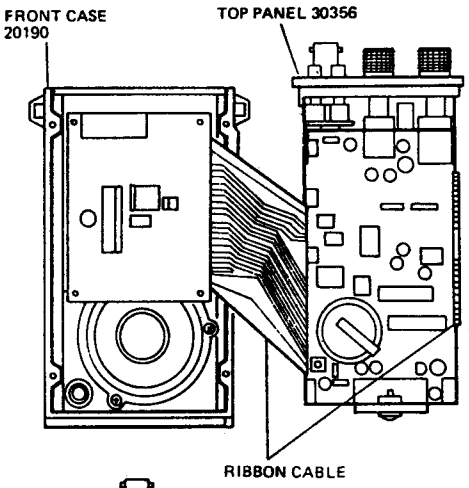
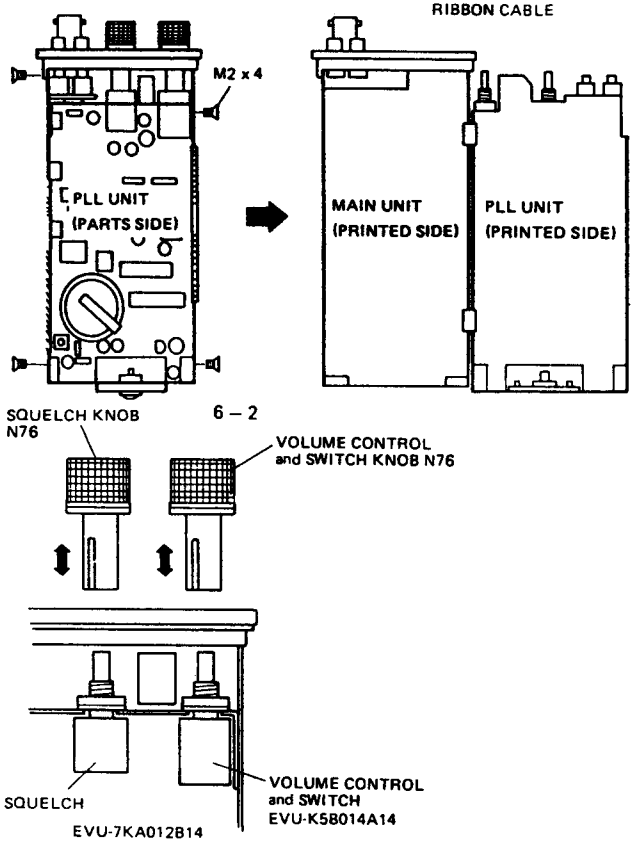


Fig. 3-1 Dual Modulus Prescaler System









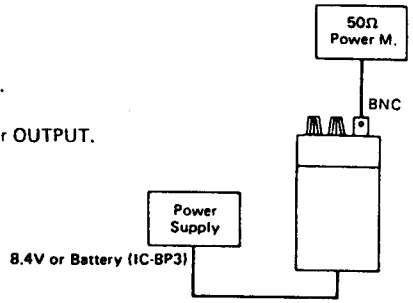
TARATURE ELETTRICHE STRUMENTI DI MISURA PER LE TARATURE

7 - 2 PRELIMINARY CHECKS

7 - 2 - 1 TRANSMITTER OUTPUT CHECKS

1. Connect a 50 ohm RF wattmeter to the ANT connector.
2. Set the frequency as follows. And observe the RF power OUTPUT.

Verson No.	Frequency
–02	145MHz
–04, –06, –07	146MHz
–05, –08, –09	148MHz



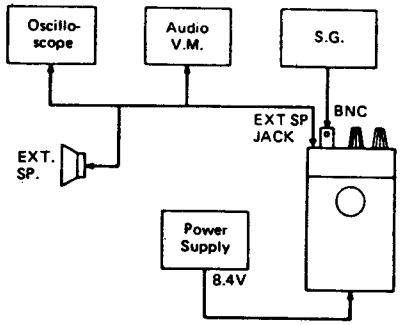
3. Power output should be 3 watts at HIGH or 0.5 watt at LOW position.

7 - 2 - 2 RECEIVER CHECKS

Make all checks at 8.4V DC

1. Settings of controls and switches

Power switch	ON
Squelch Control	Fully counterclockwise
Frequency	Same as the case of transmitter check.



2. Connect an AF voltmeter to the SP jack and set the SQL control fully counterclockwise.
3. Connect the RF output of a VHF signal generator (no modulation) to the ANT connector.
4. Adjust the VOL control and the AF voltmeter range.
   Adjust the VOL control for a full scale reading on the AF voltmeter. Don't change the VOL control setting after this adjustment.
5. Set the signal generator to the receiving frequency and adjust the output level of the signal generator until the AF voltmeter shows a 20dB decrease in reading.
6. The signal generator output voltage at this point is the 20dB quieting sensitivity.

(1) FREQUENCY COUNTER	FREQUENCY RANGE	0.1 - 160MHz
	ACCURACY	BETTER THAN ±1 ppm
	SENSITIVITY	100mV or BETTER
(2) SIGNAL GENERATOR	FREQUENCY RANGE	0.1MHz - 160MHz
	OUTPUT VOLTAGE	–20 - 90dB (0dB = 1μV)
(3) MULTIMETER		50KΩ/Volt or better
(4) AC MULTIVOLTMETER	MEASURING RANGE	10mV - 2V
(5) RF VOLTMETER	FREQUENCY RANGE	0.1 - 160MHz
	MEASURING RANGE	0.01 - 10V
(6) RF WATTMETER (Terminated Type)	MEASURING RANGE	5 Watts
	FREQUENCY RANGE	140 - 160MHz
	IMPEDANCE	50 OHMS
	SWR	LESS THAN 1.1
(7) AF OSCILLATOR	OUTPUT FREQUENCY	200 - 3000Hz
	OUTPUT VOLTAGE	0 - 100mV
	DISTORTION	LESS THAN 0.1%
(8) OSCILLOSCOPE	FREQUENCY RANGE	DC – 10MHz
	MEASURING RANGE	0.01 – 10V
(9) FM DEVIATION METER	FREQUENCY RANGE	140 ~ 160MHz
	MEASURING RANGE	0 ~ ±10KHz
(10) DIRECTIONAL COUPLER	FREQUENCY RANGE	140 ~ 160MHz
(11) AMPERMETER	MEASURING RANGE	0 ~ 2A DC
(12) DUMMY LOAD OR EXTERNAL SPEAKER	IMPEDANCE	8 OHMS
(13) VOLTAGE REGULATED POWER SUPPLY	OUTPUT VOLTAGE	5 ~ 15V DC (Adjustable)
	CAPACITY	1.5A OR MORE

7 - 3 PREPARATION AND PROCEDURE BEFORE SERVICING

1. Confirm defective operation and check to make sure setup or external sources are not the cause of the problem.
2. Proper tools and measuring instruments are required for repair and adjustment. Don't try to repair or modify without them.
3. Remove the transceiver case as shown on Page 6 - 1. Use a screw driver that fits the screw.
4. To open the hinge chassis, remove the four screws as shown on Page 6 - 2.
5. Attach an 8.0 ~ 10.0V DC external power source to the battery clip or screw. Be sure to check the polarity.
6. In the case of a transmission problem, a dummy load should be connected to the antenna connector. In the case of a receiving problem, an antenna or signal generator is connected to the antenna connector. Be careful not to transmit into the signal generator.
7. Recheck for the suspected malfunction with the power switch on.
8. Check the defective circuit and measure the DC voltages of the collector, base and emitter of each transistor.
9. When checking a transmission problem, it is convenient to shortcircuit an accessory mic connector plug and insert it, turning on the transmitter.

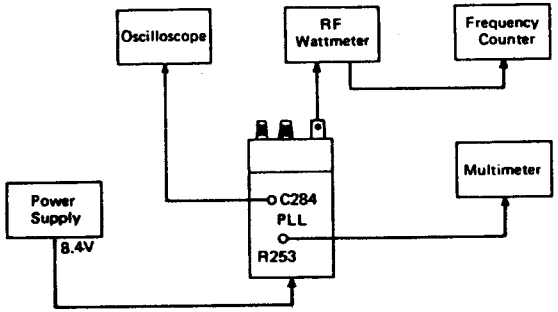
7-5 BASIC ALIGNMENT PROCEDURE

7-5-1 P.L.L. CIRCUIT

A. Lock Adjustment

1. Connect the measuring instrument as follows:
   - Connect an oscilloscope (10MHz bandwidth) to C284.
   - Connect voltmeter between R253 and ground.
   - Set the frequency as below in accordance with Adjustment and Confirmation.

Version No.	Adjustment		Confirmation	
	Frequency [MHz]	Voltage [V]	Frequency [MHz]	Voltage [V]
–02	144.000	1.5	145.9875	⩽2.5
–04	144.000	1.5	147.9875	⩽3.0
–07	144.000	1.5	147.995	⩽3.0
–05, –06, –08, –09	140.000	1.0	149.995	⩽4.0



2. Procedure

When the circuit is operating normally, adjust coil L218 in the receive mode. The P.L.L. will be locked.

- Adjust coil L218, and the voltage of R253 varies between 0 ~ 5V, and P.L.L. should be locked.
- Then, in the confirmed frequency on the list, check that the same voltage is less than the confirmed voltage.

If the P.L.L. won't lock, check voltages on lines RS5, TS5,: R+5, T+5 and +5 and the P.L.L. LO and reference frequency oscillator for oscillation. Connect a counter to R238, and check the osillation frequency of the V.C.O. during transmission.

If unlocked, check that L218 can be adjusted as follows:

- Adjust L218 to 115MHz when the voltage of R253 is 0V.
- Adjust L218 to 139MHz when the voltage of R253 is 5V.

B. Reference Frequency Oscillator Adjustment

Deviation of transmitting and receiving frequency is determined by this reference oscillating frequency. Accordingly, the adjustment would be carried out carefully.

1. Connect a counter through a capacitor to R221 (Source side of Q205).
2. Adjust C287 and set the frequency as follows:

Version No.	Operating Frequency	Setting Frequency
–02, –04, –06, –07	144.00MHz	127.1MHz ± 400Hz
–05, –08, –09	140.00MHz	123.1MHz ± 400Hz

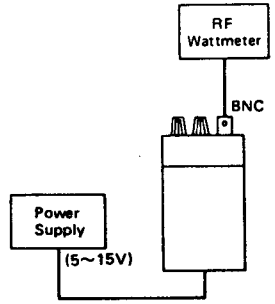
Cf: When transmitting, couple a counter loosely with a powermeter, the indication of which may be adjusted to the same value of the indication frequency.

7-5-2 TRANSMISSION

A. Power Adjustment

1. Connection of measuring instruments and setting of the knobs
   - Connect a 50 ohm powermeter to ANT connector.
   - Connect a voltmeter and variable power supply to the set. Set a power supply at 13.2V.
   - Power SW should be HIGH.
   - Set the frequency as follows:

Version No.	Frequency
–02	145MHz
–04, –06, –07	146MHz
–05, –08, –09	148MHz



2. Procedure
   - Adjust L206 though L209, L213 and L214 of the PLL unit for maximum RF power output while pushing PTT SW.
   - Adjust R267 and set output power at 5 watts.
   - Then, set the RF Power SW at LOW. Adjust R269 and set output power at 0.5 watts.

3. Confirmation

Confirm output power and current drain at the edge frequency for each version:

RF Power SW	Power supply voltage	Confirmation	
		RF output power	Current drain
HIGH	13.2V	5W ± 10%	less than 1.45A
	9V	more than 3W	less than 1.3A
	8.4V	more than 2.5W	less than 1.25A
LOW	8.4 ~ 13.2V	0.5W ± 20%	less than 0.55A

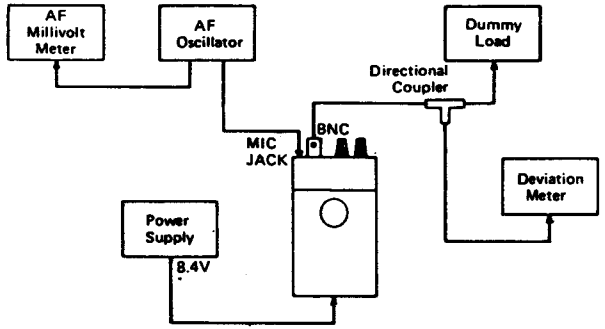
B. Modulation Adjustment

1. Connecting the measuring instrument and the settings of the controls.

Connect a deviation meter to the ANT connector through a directional coupler or attenuator.

Deviation meter filter shall be a High Pass Filter 50Hz, L.P.F. 20KHz. De-emphasis OFF.

- The frequency shall be the same as the case of power adjustment.
- Set Power SW to HIGH.
- Connect an AF oscillator, with a millivoltmeter in parallel, to the mic input. (Insert a switch in series to allow on/off transmit switching.)



2. Procedure

Mic input shall be as follows in accordance with a version. During transmit, adjust R243 on the main unit for 5KHz deviation.

Version No.	Mic input voltage
–02, –04, –07 –08, –09	1KHz 75mV RMS
–05, –06	1KHz 170mV RMS

3. Modulation check

Maximum deviation: With the above, input shall be 5KHz ±10%.

Modulation sensitivity: When deviation is 3.5KHz,

Version No.	Modulation sensitivity
–02, –04, –07 –08, –09	7.5mV ± 3dB
–05, –06	17mV ± 3dB

S/N Ratio:

Connect an AC millivoltmeter to the output terminal of the deviation meter. With no audio input to the mic input, take the voltmeter reading. Now apply 1 kHz 40mV audio into the mic connector and it's level is for 3.5KHz deviation. Take the voltmeter reading. The ratio should be greater than 40dB.

4. Spurious Emission

Connect a spectrum analyzer with appropriate attenuator. Confirm nearby random spurious signals are less than –60dB below the fundamental signal.

Measure the harmonic output, adjust RF-ATT until noise level just appears.

Should be less than –60dB below the fundamental signal.

7-5-3 RECEIVER

A. LO Output Adjustment

- Adjust the frequency as follows:

Version No.	Frequency
–02	Approx. 145MHz
–04, –06, –07	Approx. 146MHz
–05, –08, –09	Approx. 148MHz

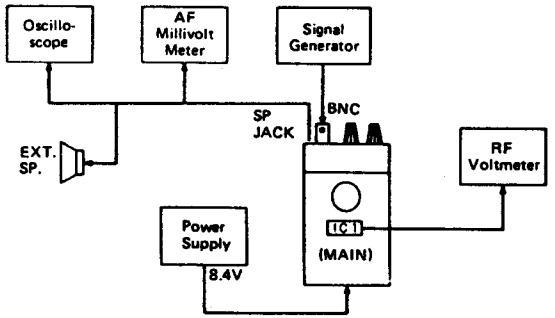
- Adjust L206, for maximum output on an RF voltmeter attached to the source of Q205 in the main unit. Output voltage should be about 180mV.

B. RF IF DET Coil Adjustment.

Using a ceramic discriminator in this set, no adjustment of DET is needed.

1. The connecting point of measuring instrument and the setting of the knob.

- Connect a signal generator to the ANT connector.
- Connect an external speaker and AF millivoltmeter to the external speaker jack.



2. Procedure

Set RF voltage meter (minimum range) to the cathode of D201, adjust L201 through L205 maximum output while setting the input from the signal generator as low as possible. Then vary the input frequency from the signal generator ±10KHz. Check if rippling (change in output level) occurs. If ripple is over 3dB, readjust L201.

3. Confirmation

Sensitivity should be less than –10dBμ for 20dB quieting.

C. 2nd LO Frequency Check
Connect a 16.445MHz amplifier to the counter, check the frequency of X202 (2nd OSC) with loose coupling the amplifier to X202. It should be: 16.445MHz ± 500Hz.

D. Receiver Spurious Response
Connect a speaker and millivoltmeter to the EXT SP jack. Connect a 50 ohm dummy load to the atenna terminal. Noise supression should be less than 3dB with any spurious response over entire frequency range.

E. Receiver Audio Output
Connect a millivoltmeter, oscilloscope, and a distortion meter to the EXT SP jack. To the ANT terminal, connect the signal generator and set the signal generator to 20 to 30dBμ and deviation to 3.5KHz. Turn up AF VOL control. Read the millivoltmeter when the distortion is 10%. Audio output should be more than 2V R.M.S.

F. S-meter
Connect a signal generator to the ANT connector and set the signal generator to +8dBμ. Adjust R205 for 8-dot lighting on the LCD meter. After that, check the full scale as rising the output level of the signal generator.

7-5-4 OTHERS

A. Tone call (version –02 and –04 only)
- Adjust the frequency at approx. 145MHz for version –02 or at approx. 146MHz for version –04.
- Connect a 7.168MHz amplifier to the counter, press the tone call SW and check the frequency of X601 with loose coupling the amplifier to X601. It should be 7.168MHz ± 500Hz.
- Connect a deviation meter to the ANT connector through a directional coupler. Adjust R603 for the deviation of 3.5KHz ± 10%.

B. Dual Tone (version –05 and –09 only)
- Adjust the frequency at approx. 146MHz.
- Connect a 3.58MHz amplifier to the counter, press the PTT SW and any button on the key pad, and check the frequency of X501 with loose coupling the amplifier to X501. It should be 3.578MHz ± 14KHz.
- Connect a deviation meter to the ANT connector through directional coupler or attenuator. Press the PTT SW and a button D on the key pad, and adjust R507 for the deviation of 3.5KHz ± 10%.

C. CTCSS Encoder (version –05 and –09 only)
- Adjust the frequency at approx. 146MHz.
- Set Tone number previously with the key pad, and select Tone number 1 (67Hz). Connect a 3.58MHz amplifier to the counter, press the PTT SW and check the frequency of X502 with loose coupling the amplifier to X502. Adjust C509 for the frequency of 3.58MHz ± 10 KHz.
- Connect a deviation meter to the ANT connector through a directional coupler or attenuator. Because of low frequencies of Tone carrier, the HPF of a deviation meter shall be off and the LPF 20KHz. Press the PTT SW and adjust R510 for the deviation of 0.5KHz ± 10%.

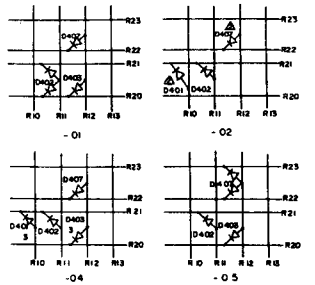
SECTION 9 VOLTAGE CHARTS

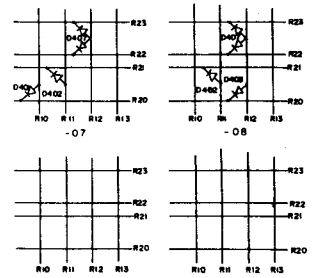
TRANSISTORS VOLTAGE CHART

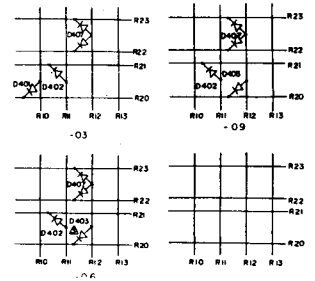
UNIT	NO.	TRANSMIT			RECEIVE			REMARKS
		BASE or GATE	COLLECTOR or DRAIN	EMITTER or SOURCE	BASE or GATE	COLLECTOR or DRAIN	EMITTER or SOURCE	
MAIN	Q101	2.4	5	2.2	0	0	0	
	Q102	2.0	4.6	2.2	0	0	0	
	Q103	4.6	2.2	5	0	0	0	
	Q104	0.9	3	GND	0	0	GND	
	Q105	0	5	4.4/0.5	1	5	4.4/0.5	Squelch closed/open
	Q106	9	13.8*	8.4	9	13.8*	8.4	*Depend on power voltage
	Q107	4.4	5	5	5	0	5	
	Q108	4.7	0	5	4.4	5	5	
	Q109	4.4	5	5	4.7	0	5	
	Q110	0	13.2	0	5	13.2	4.5	
	Q111	13.5	0	13.8	13.2	5	13.8	
	Q112	5	13.2	4.5	0	13.2	0	
	Q113	13.2	5	13.8	13.2	0	13.8	
	Q114	5	13.2	4.5	5	13.2	4.5	
	Q115	13.2	5	13.8	13.2	5	13.8	
	Q116	5.2	0.6	5	5.2	0.6	5	
	Q117	4.6	0.6	5	4.6	0.6	5	
	Q118	0.6	4	GND	0.6	4	GND	
	Q119	5	13.2	4.6	5	13.2	4.6	
	Q120	13.2	4.6	13.8	13.2	4.6	13.8	
	Q121	4.2	0.5	4.6	4.2	0.5	4.6	
	Q122	0.5	4.6	GND	0.5	4.6	GND	
	Q129	13.2	5	13.8	13.2	5	13.8	
	Q130	5	13.2	4.6	5	13.2	4.6	
	Q131	13.5	7.4/0	13.8	13.5	7.4/0	13.8	Lamp ON/Lamp OFF
PLL	Q201	0	0	GND	0.6	2.4	GND	
	Q202	0	0	0	0.6	2.8	0	
	Q203	0	0	0	1.5	2.9	0.9	
	Q204	0	0	GND	0.7	0.9	GND	
	Q205	0	0	0	0	5	1	
	Q206	0	0	0	0	4.6	1	
	Q207	0.5	5	5	5	0	0	
	Q208	2.2	5	1.5	2.2	5	1.5	
	Q209	1.7	6.4	1.1	0	0	0	
	Q210	0.7	6.4	0.6	0	0	0	
	Q211	0	4.5	0.5	0	3.8	0.5	
	Q212	2	5	2.2	2	5	2.2	
	Q213	13	6.4	13.8	13.8	0	13.8	
	Q214	0.8	8.9	GND	0	13.8	GND	
	Q215	0.7	0.3	GND	0	0.6	GND	
	Q216	2.8	0.8	2.5	0	0	0	
	Q217	2.5	GND	3.2	0	GND	0	
	Q218	4.5	5	5	4.5	5	5	

UNIT	NO.	TRANSMIT			RECEIVE			REMARKS
		BASE or GATE	COLLECTOR or DRAIN	EMITTER or SOURCE	BASE or GATE	COLLECTOR or DRAIN	EMITTER or SOURCE	
LOGIC	Q401	0.7	0.1/2.9	GND	0.7	0.1/2.9	GND	Power OFF/Power ON
	Q402	2.8/4	0/4.6	3.1/4.6	2.8/4	0/4.6	3.1/4.6	Power OFF/Power ON
TONE	Q501	0/2.2	0/2.3		0	0		T/DTMF
	Q502	0/2.2	0/2.3		0	0		T/DTMF
	Q503	0/2.2	0/2.3		0	0		T/DTMF
	Q504	0/2.2	0/2.3		0	0		T/DTMF
	Q505	0.6	5	5	4.4	0	5	T/DTMF
	Q506	0/0.6	1.8/0	GND	0	4.8	GND	T/DTMF
TONE CALL	Q601	4.8/4.2	0/5	5	4.8	0	5	T/CAL

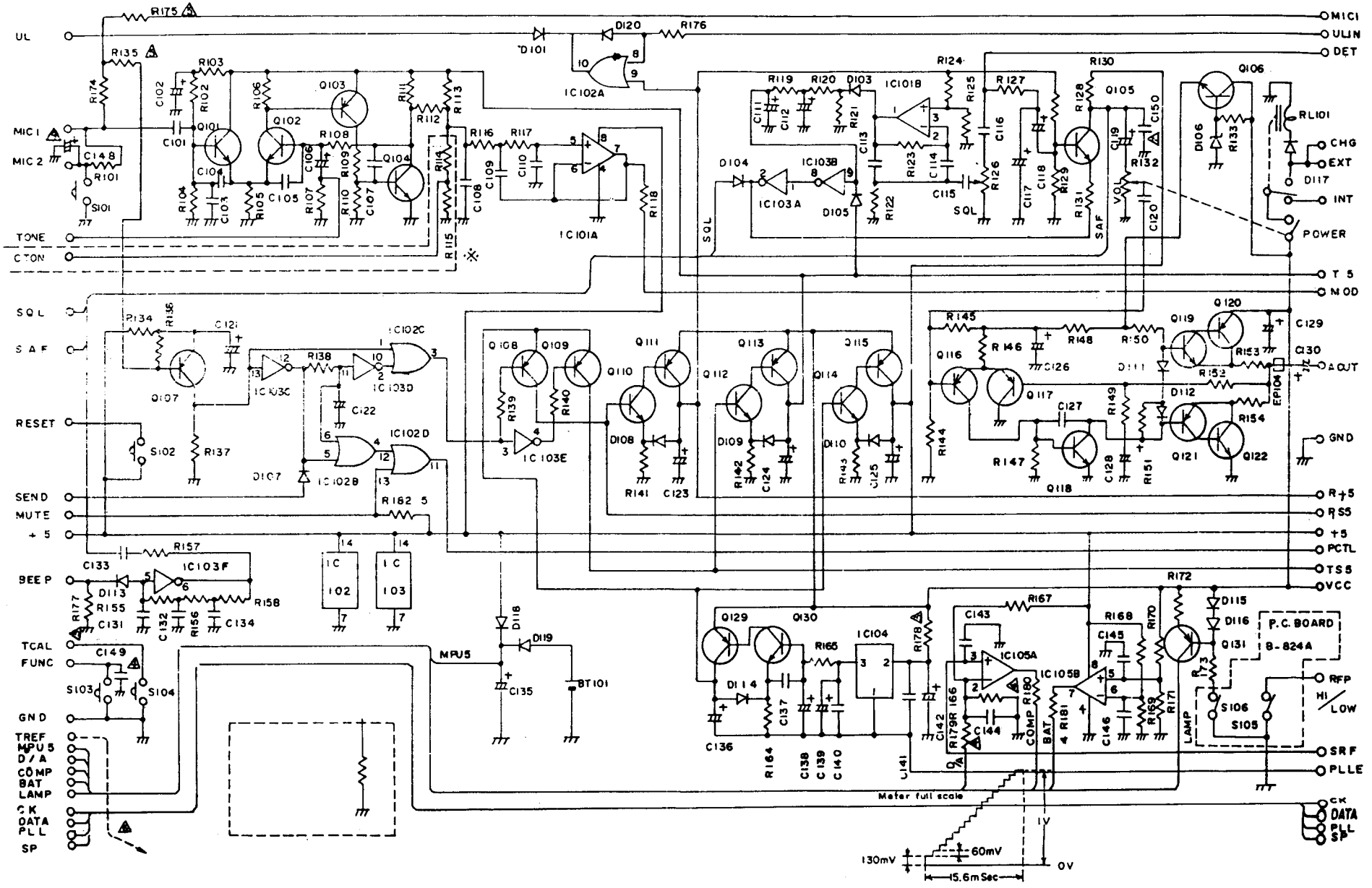
DIODE MATRIX for each version



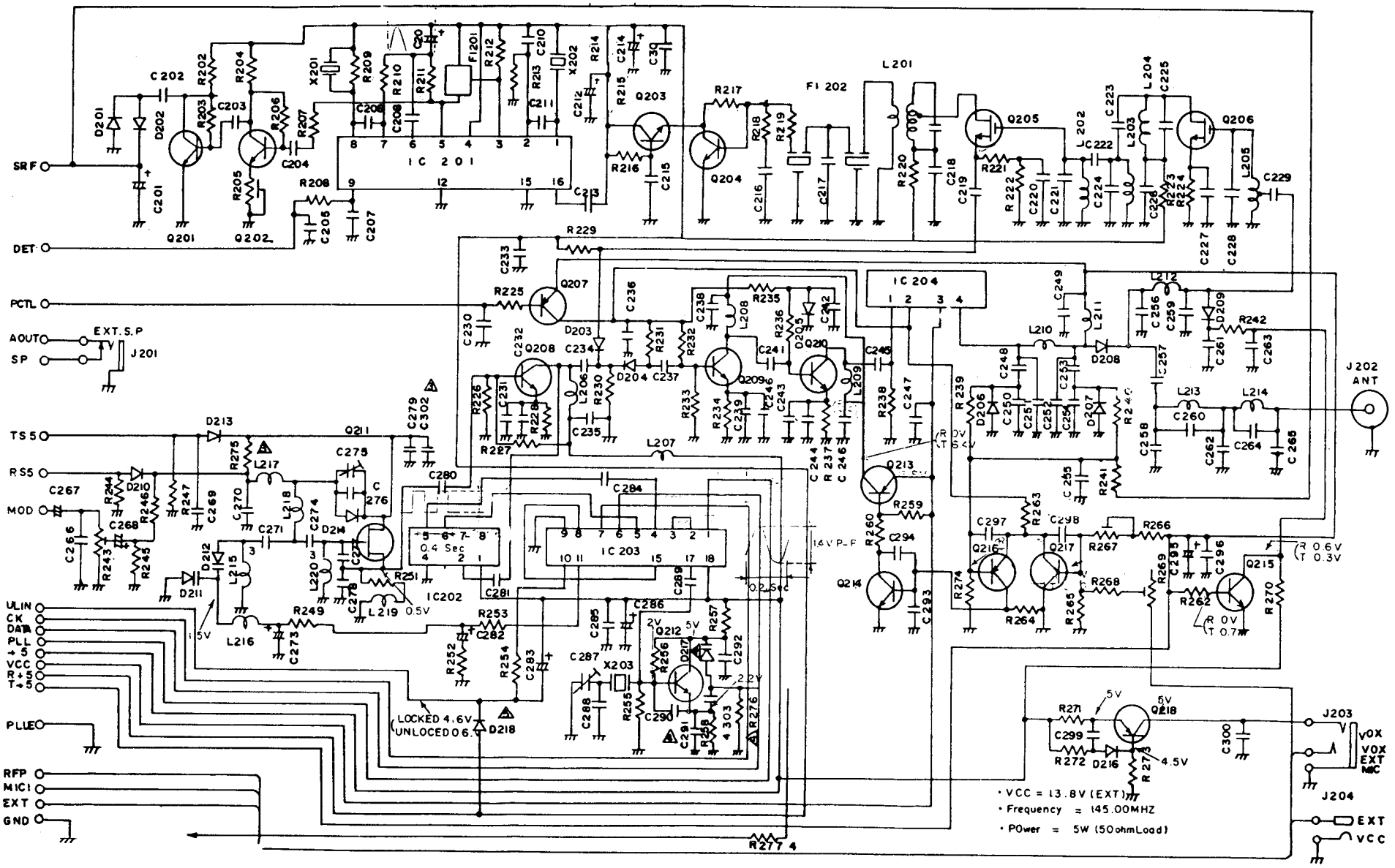




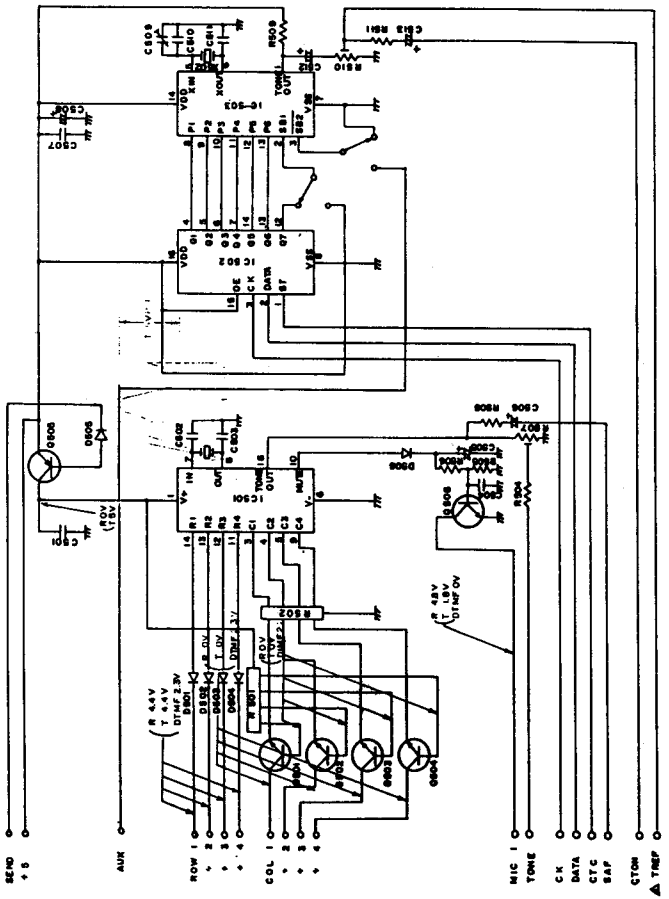
MAIN UNIT VOLTAGE DIAGRAM



PLL UNIT VOLTAGE DIAGRAM



TONE UNIT VOLTAGE DIAGRAM (IC-02AT only)



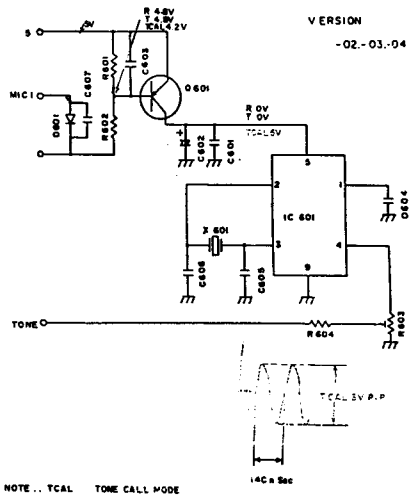
Code and Tone Frequency of P1 ~ P6

fosc = 3.579545 MHz

TONE NO.	FREQUENCY (Hz) NOMINAL	FREQUENCY (Hz) ACTUAL	DIVIDING RATIO	P1	P2	P3	P4	P5	P6
01	67.0	66.98	1670	1					
02	71.9	71.89	1556		1				
03	74.4	74.38	1504	1	1				
04	77.0	76.99	1453			1			
05	79.7	79.67	1404	1		1			
06	82.5	82.49	1356		1	1			
07	85.4	85.39	1310	1	1	1			
08	88.5	88.50	1264				1		
09	91.5	91.46	1223	1			1		
10	94.8	94.80	1180		1		1		
11	97.4	97.44	1148	1	1		1		
12	100.0	99.96	1119			1	1		
13	103.5	103.48	1081	1		1	1		
14	107.2	107.25	1043		1	1	1		
15	110.9	110.86	1009	1	1	1	1		
16	114.8	114.85	974					1	
17	118.8	118.75	942	1				1	
18	123.0	123.06	909		1			1	
19	127.3	127.26	876	1	1			1	
20	131.8	131.76	849			1		1	
21	136.5	136.58	819	1		1		1	
22	141.3	141.24	792		1	1		1	
23	146.2	146.22	765	1	1	1		1	
24	151.4	151.37	739				1	1	
25	156.7	156.67	714	1			1	1	
26	162.2	162.12	690		1		1	1	
27	167.9	167.96	666	1	1		1	1	
28	173.8	173.70	644			1	1	1	
29	179.9	179.84	622	1		1	1	1	
30	186.2	186.12	601		1	1	1	1	
31	192.8	192.86	580	1	1	1	1	1	
32	203.5	203.38	550						1
33	210.7	210.66	531	1					1
34	218.1	218.50	513		1				1
35	225.7	225.53	496	1	1				1
36	233.6	233.53	479			1			1
37	241.8	241.60	463	1		1			1
38	250.3	250.25	447		1	1			1
39	500	499.4	224	1	1	1			1
40	600	601.4	186				1		1
41	700	699.1	160	1			1		1
42	800	799.0	140		1		1		1
43	900	902.1	124	1	1		1		1
44	1000	998.8	112			1	1		1
45	1600	1598.0	70	1		1	1		1
46	1700	1694.9	66		1	1	1		1
47	1750	1747.8	64	1	1	1	1		1
48	1800	1804.2	62					1	1
49	1300	1300.7	86	1				1	1
50	2000	1997.5	56		1			1	1
51	2200	2193.3	51	1	1			1	1
52	2975	2943.7	38			1		1	1
53	2550	2542.3	44	1		1		1	1
54	2295	2282.9	49		1	1		1	1
55	2125	2110.6	53	1	1	1		1	1
56	1275	1271.1	88				1	1	1
57	1445	1452.7	77	1			1	1	1

Note: Input voltage of $P_1 \sim P_6$; 1 = V_{DD}, blank = V_{SS} or open.

TONE-CALL UNIT VOLTAGE DIAGRAM (IC-02E only)



NOTE .. TCAL TONE CALL MODE

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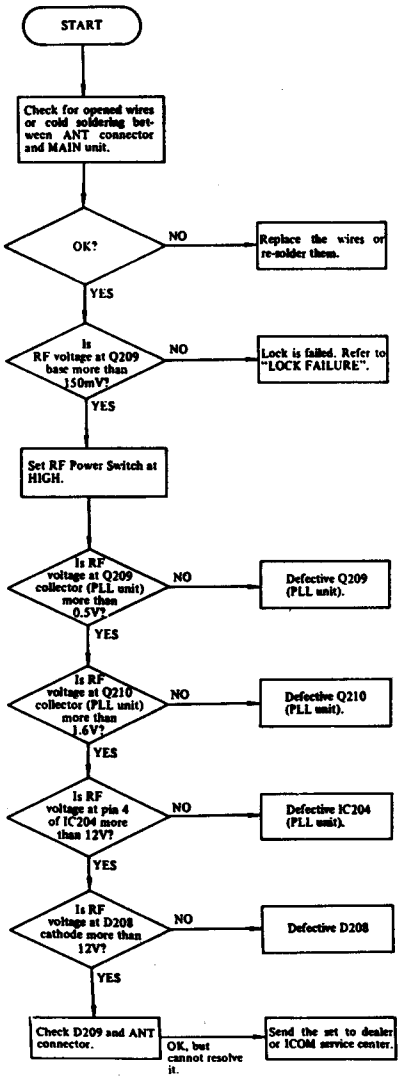
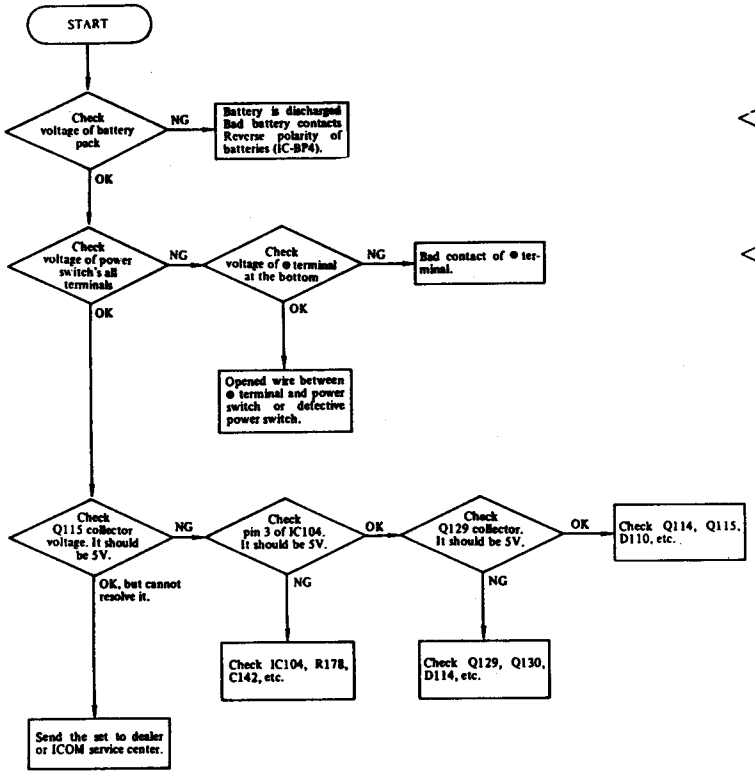
NO TRANSMIT RF POWER

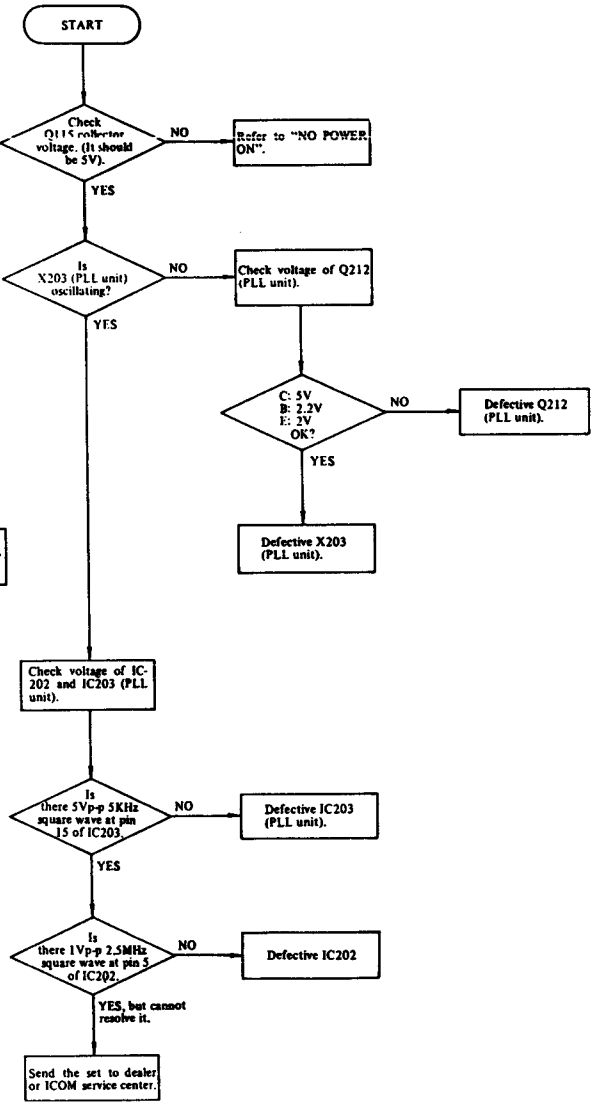

START
Check for opened wires or cold soldering between ANT connector and MAIN unit.
OK?
NO
Replace the wires or re-solder them.
YES
Is RF voltage at Q209 base more than 150mV?
NO
Lock is failed. Refer to "LOCK FAILURE".
YES
Set RF Power Switch at HIGH.
Is RF voltage at Q209 collector (PLL unit) more than 0.5V?
NO
Defective Q209 (PLL unit).
YES
Is RF voltage at Q210 collector (PLL unit) more than 1.6V?
NO
Defective Q210 (PLL unit).
YES
Is RF voltage at pin 4 of IC204 more than 12V?
NO
Defective IC204 (PLL unit).
YES
Is RF voltage at D208 cathode more than 12V?
NO
Defective D208
YES
Check D209 and ANT connector.
OK, but cannot resolve it.
Send the set to dealer or ICOM service center.

NO POWER ON

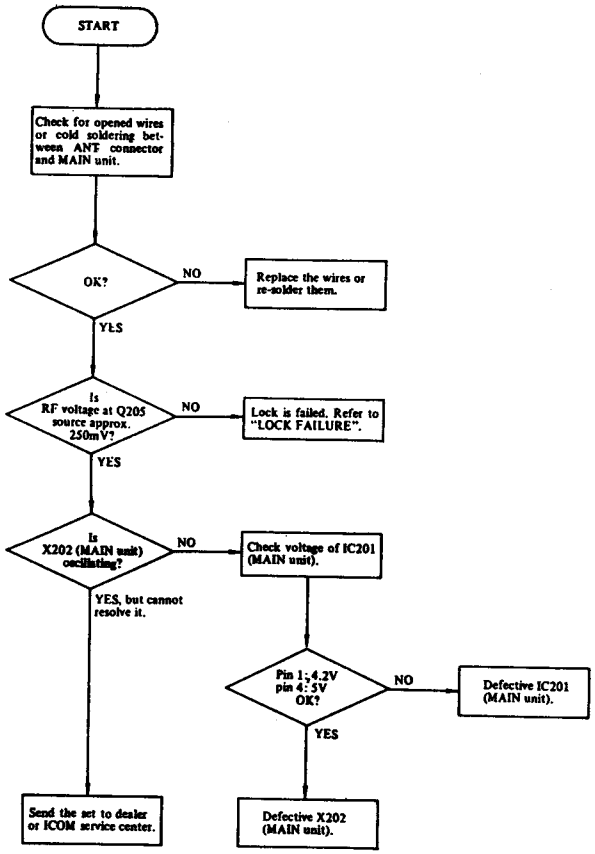

START
Check voltage of battery pack
NG
Battery is discharged
Bad battery contacts
Reverse polarity of batteries (IC-BP4).
OK
Check voltage of power switch's all terminals
NG
Check voltage of ● terminal at the bottom
NG
Bad contact of ● terminal.
OK
Opened wire between ● terminal and power switch or defective power switch.
Check Q115 collector voltage. It should be 5V.
NG
Check pin 3 of IC104. It should be 5V.
OK
Check Q129 collector. It should be 5V.
OK
Check Q114, Q115, D110, etc.
OK, but cannot resolve it.
NG
Check IC104, R178, C142, etc.
NG
Check Q129, Q130, D114, etc.
Send the set to dealer or ICOM service center.

IC-02A/AT/E

LOCK FAILURE



NO RECEPTION


START
Check for opened wires or cold soldering between ANT connector and MAIN unit.
OK?
NO
Replace the wires or re-solder them.
YES
Is RF voltage at Q205 source approx. 250mV?
NO
Lock is failed. Refer to "LOCK FAILURE".
YES
Is X202 (MAIN unit) oscillating?
NO
Check voltage of IC201 (MAIN unit).
YES, but cannot resolve it.
Pin 1: 4.2V pin 4: 5V OK?
NO
Defective IC201 (MAIN unit).
YES
Send the set to dealer or ICOM service center.
Defective X202 (MAIN unit).

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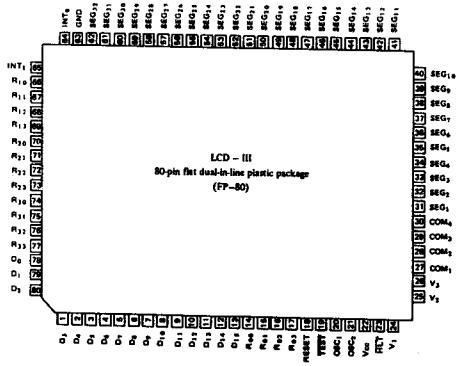
HD 44795 (MPU)

MAXIMUM RATINGS

SYMBOL	DESCRIPTION	RATINGS	UNIT	REMARKS
V_{CC}	Supply Voltage	− 0.3 ~ + 7.0	V	
V_{T1}	Lead Voltage (1)	− 0.3 ~ Vcc + 0.3	V	Note 1)
V_{T2}	Lead Voltage (2)	− 0.3 ~ + 10.0	V	Note 2)
$-\Sigma I_{OL}$	Maximum Output Current (1)	45	mA	
ΣI_{OL}	Maximum Output Current (2)	45	mA	
T_{OPR}	Operating Temperature	− 20 ~ + 75	°C	
T_{STG}	Storage Temperature	− 55 ~ + 125	°C	

Note 1): Use all pins except V_{T1}.
Note 2): Use open drain output pins and input and output pins.

PIN CONNECTION



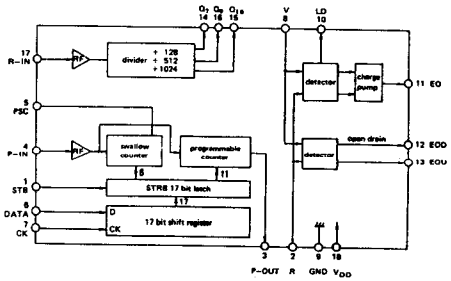
μPD 2834C (PLL FREQUENCY SYNTHESIZER)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT	REMARKS
V_{DD}	Supply Voltage	− 0.3 ~ + 7.0	V	
V_{IN}	Input Voltage	− 0.5 ~ + V_{DD} + 0.5	V	
V_{OUT}	Output Voltage	− 0.5 ~ + V_{DD} + 0.5	V	
V_{OUT}	Output Voltage	− 0.5 ~ + V_{DD} + 3.0	V	EOU pins only
T_{OPR}	Operating Temperature	− 40 ~ + 85	°C	
T_{STR}	Storage Temperature	− 65 ~ + 150	°C	

PIN CONNECTION

BLOCK DIAGRAM

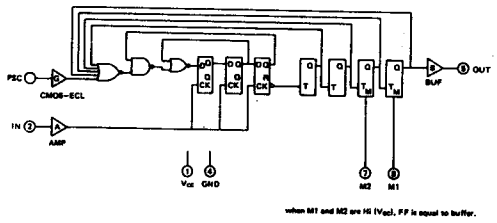


μPD571C (LOW POWER PRESCALER)

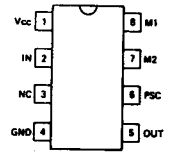
MAXIMUM RATINGS (ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{CC}	Supply Voltage (MAX)	− 0.5 ~ + 6.0	V
V_{IN}	Input Voltage	− 0.5 ~ + Vcc + 0.5	V
I_O	Output Current	− 10	mA
T_{STG}	Storage Temperature	− 55 ~ + 125	°C

BLOCK DIAGRAM



when M1 and M2 are Hi (V_{CC}), FF is equal to buffer.

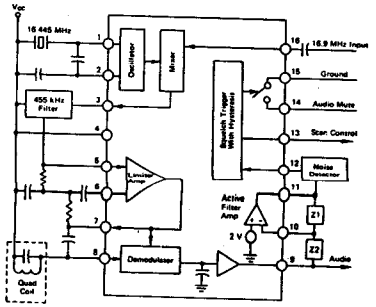


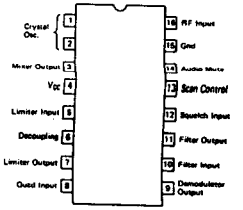
MC3357 (LOW POWER FM IF)

MAXIMUM RATINGS

SYMBOL	DESCRIPTION	RATINGS	UNIT
Vcc (max)	Power Supply Voltage	12	Vdc
Vcc	Operating Supply Voltage	4 or 8	Vdc
-	Detector Input Voltage	1.0	V_{p-p}
V_{16}	Input Voltage (Vcc ≥ 6.0 Volts)	1.0	V_{RMS}
V_{14}	Mute Function	- 0.5 to 5.0	V_{dc}
T_J	Junction Temperature	150	°C
T_A	Operating Ambient Temperature Range	− 30 to + 70	°C
T_{STG}	Storage Temperature Range	− 65 to + 150	°C

BLOCK DIAGRAM



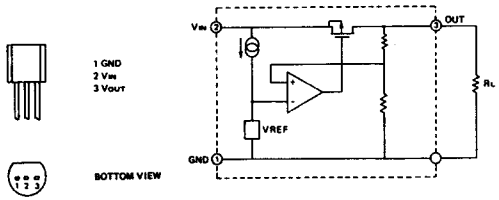


S-81250HG (C-MOS VOLTAGE REGULATOR)

MAXIMUM RATINGS

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{IN}	Input Voltage	18	V
I_{OUT}	Output Current	100	mA
V_{OUT}	Output Voltage	V_{IN} + 0.3 ~ V_{SS} − 0.3	V
Pd	Permissible Dissipation	200	mW
T_{OPR}	Operating Temperature	− 20 ~ + 70	°C
T_{STG}	Storage Temperature	− 40 ~ + 125	°C

BLOCK DIAGRAM

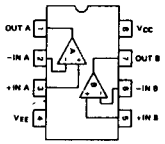


TA75393P (DUAL COMPARATOR)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{CC}	Supply Voltage	± 18 ~ 36	V
DVIN	Drive Input Voltage	± 36	V
CMVIN	Compare Input Voltage	− 0.3 ~ V_{CC}	V
PD	Permissible Dissipation	500	mW
T_{OPR}	Operating Temperature	− 40 ~ 85	°C
T_{STG}	Strage Temperature	− 55 ~ 125	°C

PIN CONNECTION



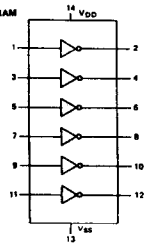
TC4069UBP (HEX INVERTER)

MAXIMUM RATINGS

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{DD}	Supply Voltage	V_{SS} − 0.5 ~ V_{SS} + 20	V
V_{IN}	Input Voltage	V_{SS} − 0.5 ~ V_{DD} + 0.5	V
V_{OUT}	Output Voltage	V_{SS} − 0.5 ~ V_{DD} + 0.5	V
I_{IN}	Input Current	± 10	mA
PD	Permissible Dissipation	300	mW
T_{STG}	Strage Temperature	− 65 ~ 150	°C
T_{SOL}	Soldering Temperature and Time	260°C · 10 sec	

PIN CONNECTION

BLOCK DIAGRAM

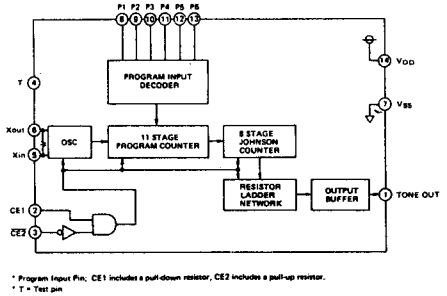


S-7116A TONE GENERATOR C-MOS LSI

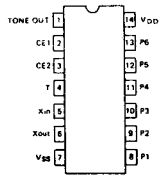
MAXIMUM RATING

SYMBOL	DESCRIPTION	RATINGS Min.	RATINGS Max.	UNIT
V_{DD} − V_{SS}	Supply Voltage		12.0	
V_{IN}	Input Voltage	V_{SS} − 0.3	V_{DD} + 0.3	V
V_{OUT}	Output Voltage	V_{SS} − 0.3	V_{DD} + 0.3	
T_{OPR}	Operating Temperature	− 25	+ 70	°C
T_{STG}	Storage Temperature	− 40	+ 125	
Pd	Permissible Dissipation		300	mW

BLOCK DIAGRAM



* Program Input Pin; CE1 includes a pull-down resistor, CE2 includes a pull-up resistor.
* T = Test pin



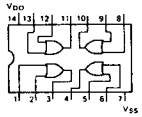
TC4071BP (QUAD 2-INPUT POSITIVE OR GATE)

MAXIMUM RATINGS

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{DD}	Supply Voltage	V_{SS} − 0.5 ~ V_{SS} + 20	V
V_{IN}	Input Voltage	V_{SS} − 0.5 ~ V_{DD} + 0.5	V
V_{OUT}	Output Voltage	V_{SS} − 0.5 ~ V_{DD} + 0.5	V
I_{IN}	Input Current	± 10	mA
PD	Permissible Dissipation	300	mW
T_{STG}	Strage Temperature	− 65 ~ 150	°C
T_{SOL}	Soldering Temperature and Time	260°C · 10 sec	

PIN CONNECTION

BLOCK DIAGRAM

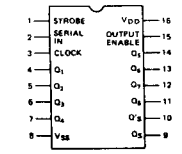


TC4094BP (8-STAGE SHIFT-AND-STORE BUSREGISTER)

MAXIMUM RATINGS

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{DD}	Supply Voltage	V_{SS} − 0.5 ~ V_{SS} + 20	V
V_{IN}	Input Voltage	V_{SS} − 0.5 ~ V_{DD} + 0.5	V
V_{OUT}	Output Voltage	V_{SS} − 0.5 ~ V_{DD} + 0.5	V
I_{IN}	Input Current	± 10	mA
PD	Permissible Dissipation	300	mW
T_{STG}	Storage Temperature	− 65 ~ 150	°C
T_{SOL}	Soldering Temperature and Time	260°C · 10 sec	

PIN CONNECTION



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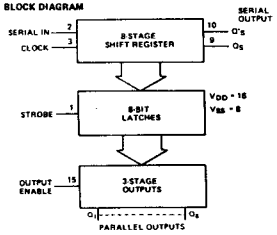
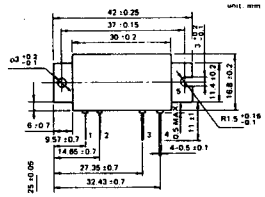


SC-1025 (VHF POWER AMPLIFIER MODULE)

MAXIMUM RATINGS

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{CC}	Supply Voltage	16	V
V_{BB}	Bias Voltage	6	V
P_i	Input Power	300	mW
$T_{C(OP)}$	Operating Temperature	30 ~ 100	°C
T_{STG}	Strage Temperature	40 ~ 110	°C

PIN CONNECTOR

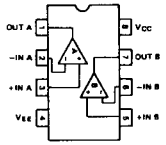


TA75358P (DUAL DRIVER)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{CC}, V_{EE}	Supply Voltage	± 18, 36	V
DVIN	Drive Input Voltage	± 36	V
V_{IN}	Input Voltage	− 0.3 ~ 36	V
PD	Permissible Dissipation	500	mV
T_{OPR}	Operating Temperature	− 40 ~ 85	°C
T_{STG}	Strage Temperature	− 55 ~ 125	°C

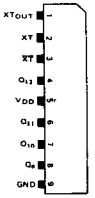
PIN CONNECTION



TC5082P (OSCILLATOR AND 12 STAGE DIVIDER)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{DD}	Supply Voltage	10	V
V_{IN}	Input Voltage	0.3 ~ V_{DD} + 0.3	V
T_{OPR}	Operating Temperature	− 30 ~ 75	°C
T_{STG}	Storage Temperature	− 55 ~ 125	°C



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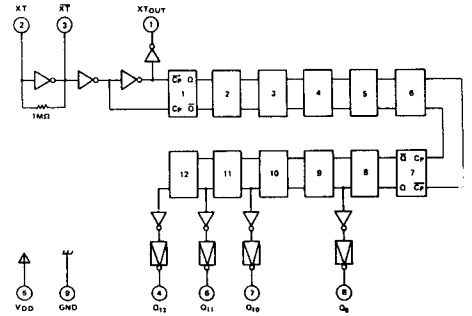
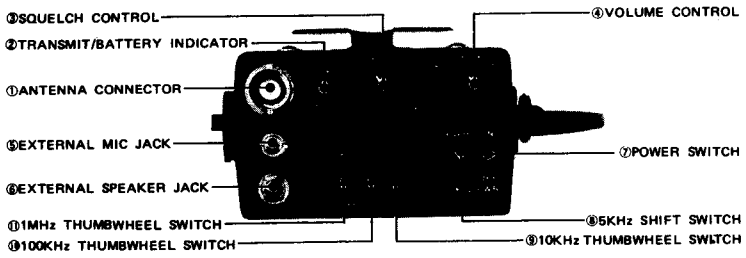
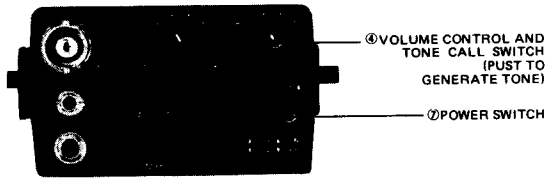


ICOM IC-2A/AT/E

TOP PANEL

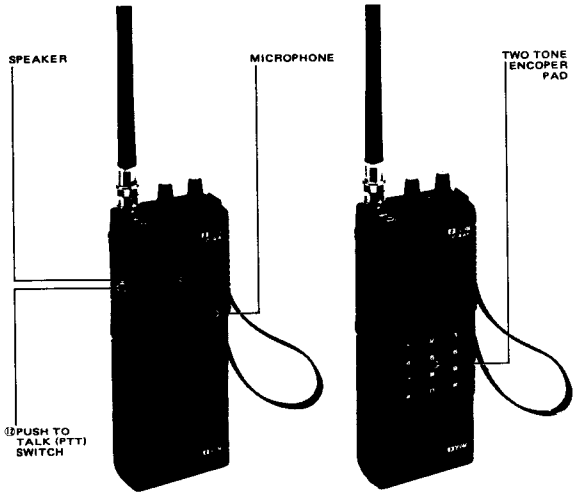


IC-2A/2AT



IC-2E

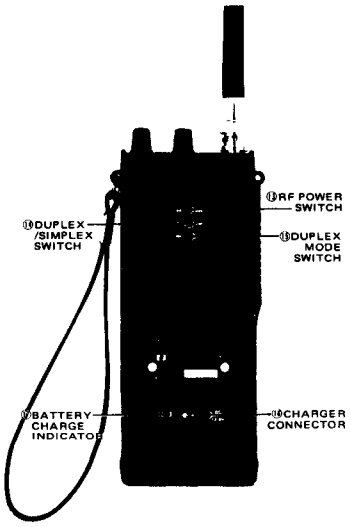
FRONT PANEL



IC-2A, IC-2E

IC-2AT

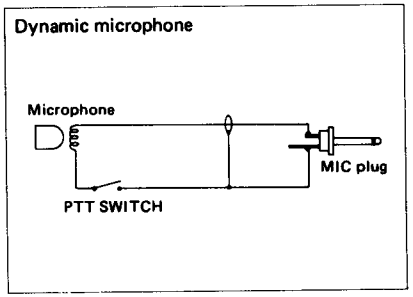
REAR PANEL

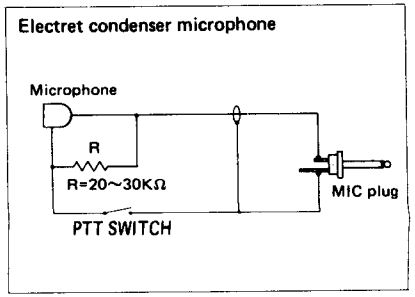


⑪ 1MHz THUMBWHEEL SWITCH

Sets 1MHz digit of the desired operating frequency. When you set a digit of a frequency that is out of the band, the set will work as follows:

Digit	Actual working frequency band	
	IC-2Au, IC-2Ao, IC-2AT, IC-2E1	IC-2EDL
0	144MHz	144MHz
1	145	145
2	146	144
3	147	145
4	144	144
5	145	145
6	146	144
7	147	145
8	144	144
9	145	145





SECTION 3 CIRCUIT DESCRIPTION

3-1 RECEIVER CIRCUITS

3-1-1 ANTENNA SWITCHING CIRCUIT

Signals from the antenna connector are fed to the antenna switching circuit through Chebyshev low-pass filter consisting of L29, L30, C95, C97 and C98 in the PLL board.

The antenna switching circuit employs a quater wave switching circuit.

In the receive mode, switching diodes, D16 and D17 are turned OFF, and they make isolation against the transmitter circuit and matching circuit, and the incoming signals are fed to the RF amplifier.

3-1-2 RF AMPLIFIER AND FIRST MIXER

The signals from the switching circuit are fed to the cascode amplifier Q1 and Q2.
The amplified signals are fed to the gate of the first mixer Q3 through the band-pass filter L2 ~ L4, which reduces interference and intermodulation from out of the band signals.

To the source of Q3, a 133MHz signal is supplied from the PLL circuit to convert the RF signals into 10.695MHz first IF signals.

The first IF signals are taken from the drain of Q3 and fed to the IF circuit.

3-1-3 IF CIRCUIT

The first IF signals from Q3 are fed to the matched pair crystal filter FI1, then IF amplifiers Q4 and Q5.

The amplified signals are fed to IC1. IC1 is composed of the second local oscillator, second mixer, limiter amplifier, quadrature detector and active filter circuits.

The second local oscillator oscillates 10.240MHz with X1, and is fed to the second mixer with the first IF signals to convert into 455KHz second IF signals. The second IF signals are put out from Pin 3, and fed to external ceramic filter FI2 which has excellent selectivity, then fed to IC1 (Pin 5) again to amplify and detect.
The detected AF signals are put out from Pin 9.

3-1-4 AF AND SQUELCH CIRCUITS

The detected AF signals are put 6dB/Octave de-emphasis by integral circuit consisting of R17 and C26, and fed to AF power amplifier IC2 through the VOLUME control R1, to obtain enough power to drive the speaker.

Noise components put out from Pin 9 of IC1 are fed to IC1 (Pin 10) again through the SQUELCH control R2, which controls the squelch threshold level, filtered about 20KHz signal (noise) and put out from Pin 11.

This signal (noise) is rectified by Q13, integrated by R35, R36 and C36, and turns Q14 ON and turns OFF the regulator for AF power amplifier consisting of D3, Q15 and Q16.

This reduces the current drain of the set, in the standby condition. When a signal is received, noise is suppressed by the signal and turns Q14 OFF and the regulator is turned ON and supplies regulated voltage to the AF power amplifier, and incoming signal can be heard from the speaker.
In the transmit mode, a voltage is applied to Q14 and turns it ON, and turns the regulator OFF the same as in the standby condition.

3-2 TRANSMITTER CIRCUITS

3-2-1 MIC AMPLIFIER CIRCUIT

Audio signals from the microphone are fed to the limiter amplifier, consisting of Q25 ~ Q28, which has 6dB/Octave response between 300Hz and 3KHz.

The output of the limiter amplifier is similar to rectangular waves and includes harmonics.
These harmonics are eliminated by the low-pass filter Q29, which cuts 3KHz or higher.
Filtered signals are fed to the VCO in the PLL board to make modulation.

3-2-2 MULTIPLIER AND DRIVER CIRCUITS

The VCO oscillates a half of a transmitting frequency, thus the multiplier Q8 and Q9, multiplies it two times to obtain 144MHz transmitting frequency.

This 144MHz is fed to amplifiers Q11 and Q12 through band-pass filter L19, L20 and L21, L22 to obtain 200 milliwatts pure 144MHz signal. While switching from receive to transmit, Q10 is turned ON by the charged voltage of C69, until the charged voltage has been discharged, and this function cuts the bias voltage of Q11 ~ Q13.

This prevents transmission of unwanted signals.

3-2-3 POWER AMPLIFIER CIRCUIT

The output signals from Q12 is fed to the power amplifier Q13, and amplified to 1.5 watts.
In the transmit mode, D16 and D17 are turned ON, and D17 makes L28 have high-impedance and D16 feeds the signals to the antenna through the low-pass filter.

3-3 PLL CIRCUITS

3-3-1 LOCAL OSCILLATOR CIRCUIT

The crystal oscillator Q6 oscillates 32.32625MHz with X2 for receive, 35.000MHz with X3 for simplex transmit, 35.150MHz with X4 for +600KHz and 34.850MHz with X5 for −600KHz duplex transmit, and the signal at two times this frequency is taken from the collector of Q7, and fed to the mixer of the PLL circuit.

In the receive mode, R+5V is applied to D10 through R23, L7, L11 and R27 and D10 is turned ON and selects X2.

In the simplex transmit mode, T+5V is applied to D11 through R24, L8, L12 and R28 and D11 is turned ON and selects X3.

In the +600KHz duplex transmit mode, T+5V is applied to D12 through R25, L9, L13 and R29 and D12 is turned ON and selects X4.

In the −600KHz duplex transmit mode, T+5V is applied to D13 through R26, L10, L14 and R30 and D13 is turned ON and selects X5.

When the operating frequency has a 5KHz digit, cathodes of D6 ~ D9 are grounded through the 5KHz SHIFT switch, and one of D6 ~ D9 is turned ON according to the operating mode. Thus, one of L7 ~ L10 is shunted accordingly and oscillating frequency is shifted 5KHz (on the operating frequency).

3-3-2 MIXER, LOW-PASS FILTER AND AMPLIFIER CIRCUITS

The output signals from the local oscillator circuit and the VCO signals fed through buffer amplifiers Q2 and Q3 are mixed by the mixer Q4. The output signals are fed to the low-pass filter to filter out only the signals below 5MHz, then fed to Q5 to be amplified to proper drive level (more than 3Vp-p) of the programmable divider IC1.

3-3-3 PROGRAMMABLE DIVIDER CIRCUIT

The input signals at Pin 2 of IC1 are divided by the BCD input signals from the thumbwheel switches at Pin 3 ~ 14.

The programmable divider is also called the 1/N counter and the BCD value is N.
The relationship between the operating frequency and the divide number N is:

N (divide number of programmable divider) = (Receive frequency (MHz) – 140) / 0.01

3-3-4 REFERENCE FREQUENCY GENERATOR CIRCUIT

Reference frequency generator IC3 consists of a crystal oscillator and a highspeed divider. X1 oscillates at 5.12MHz, which is divided by 1024. The 5KHz reference frequency is fed to phase detector IC2. This 5KHz reference frequency decides the variation step of the PLL output frequency.

3-3-5 PHASE DETECTOR AND LOOP FILTER CIRCUITS

Digital phase detector, IC2, detects the phase difference of the pulse signals of the 5KHz reference frequency and the output signal of the programmable divider, and proportionately puts out pulse signals at Pin 3, which becomes high impedance when the PLL is locked.

Pin 4 is for detecting the lock failures and changes to ground level according to the phase difference of the two pulse signals. When the lock fails, the pulse signal from Pin 4 is integrated by R2 and C15. When the integrated voltage exceeds the junction voltage of Q14's base, Q14 is turned ON and then Q7 in the MAIN board is turned ON.

The collector of Q7 is connected to the base of Q8, so the base voltage of Q8 becomes ground level, and Q8 and Q6 are shut off to prevent transmitting unwanted signals.

The loop filter, consisting of R4, R5, R6, C13 and C14, converts the pulse signal from Pin 3 into a DC voltage and decides the response time of the whole loop.

The output signals are fed to tuning diode D3 of the VCO circuit as the control voltage for the VCO frequency set.

3-3-6 VCO CIRCUIT

The VCO (Voltage-Controlled Oscillator) is a Colpitts circuit using Q1, and oscillates in 70MHz range.

The oscillator frequency is controlled by a DC voltage which is supplied from the loop filter to varactor diode D3.

In the receive mode, R+5V is applied to D4's anode through L1, and D4 is turned ON and shunts C20. Thus the free-run frequency of the VCO is lowered.

In the transmit mode, T+5V is applied to D4's cathode through D5 and L2, D4 is turned OFF, and C20 is inserted in the oscillator circuit in series. Thus the free-run frequency of the VCO is increased. In the same time, the VCO signal is frequency modulated by the audio signals from the microphone which are applied to the gate of Q1 and varies Q1's mutual conductance.

3-4 OTHER CIRCUITRY

3-4-1 POWER SUPPLY CIRCUIT

The regulated 5V is supplied to the main circuits, so that the set operates under a stable condition with as low a power voltage as possible.

The power supply voltage is fed to the AF power amplifier through the squelch switching circuit and to the 5V regulator consisting of Q17 ~ Q20 and zener diode D4. This regulated 5V is supplied to the PLL circuit.

In the transmit mode, the base of Q23 is grounded through R55, the microphone and the PTT switch, and Q23 is turned ON. Thus Q6 and Q8 are turned ON and T+5V is actuated, and supplied to the transmitter circuit. At the same time, T+5V turns Q12 ON, and the power supply voltage is applied to the MIC amplifier circuit through Q12.

In the receive mode, Q23 is turned OFF and the bias voltage of Q9 ON. Thus the R+5V is actuated and supplied to the PLL board to switch the local oscillator crystal and the driver transistors of the transmitter circuit.

At the same time, R+5V turns ON the voltage boost circuit consisting of Q10 and Q11, and +6V is supplied to the receiver circuit.

LED INDICATOR CIRCUIT

This LED is lit in the transmit mode, but when the power supply voltage becomes less than 5.5V, it will not be lit.

The power supply voltage is divided by R48 and R49, and applied to the base of Q21. The emitter of Q21 is connected to the regulated 5V source. When the power supply voltage is more than 5.5V, Q21 is turned OFF, Q22 is turned ON and T+5V is applied to the LED through Q22 and R50, and LED is lit.

3-4-2 TWO-TONE ENCODER CIRCUIT (IC-2AT only)

IC1 is a standard 12 key two-tone encoder which is compatible with any telephone system. When a key is pushed, IC1 oscillates 3.5795MHz with X1, and its signal is divided depending on the pushed key, and a pair of tones is put out from Pin 16. At this time, Pin 10 of IC1 puts out H-level signal, and this is used to mute the mic amplifier.

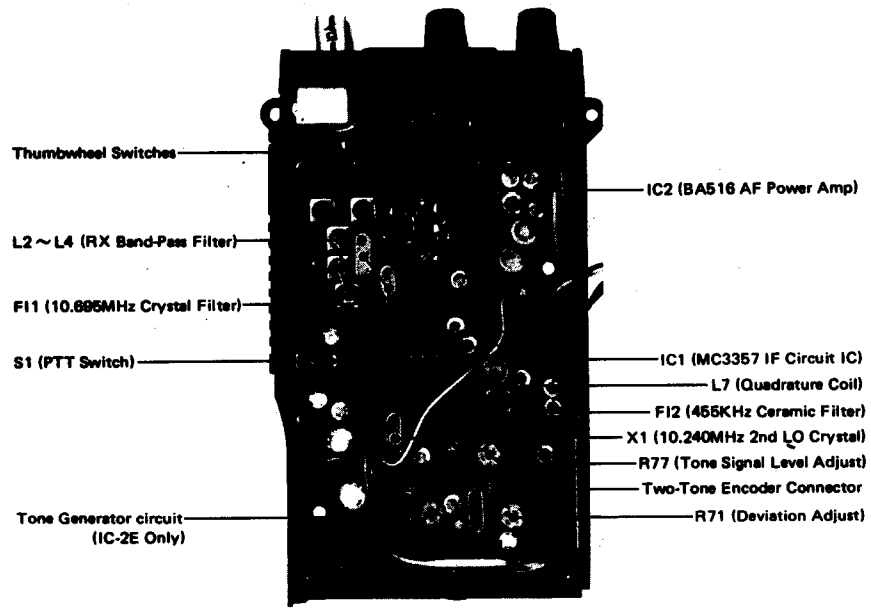
3-4-3 TONE-BURST GENERATOR CIRCUIT (IC-2E only)

When the TONE CALL switch is depressed, Q23's base is grounded through R55 and D6, and the set is turned in the transmit mode. At the same time, Q33's base is also grounded through R83, and Q33 is turned ON and supplies a voltage to IC3.

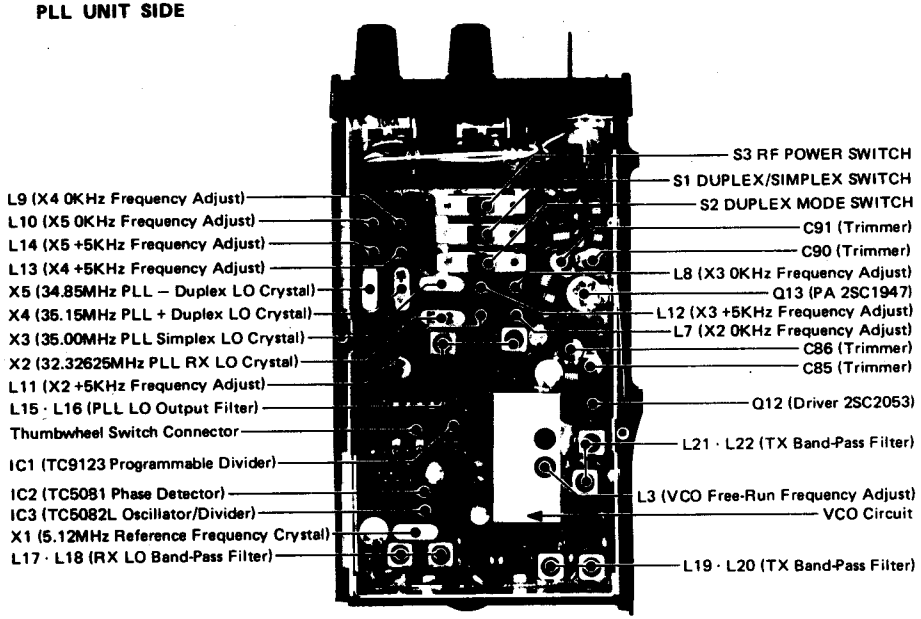
IC3 consists of a crystal oscillator and dividers. X2 oscillates at 7.168MHz, which is divided by 4096.

The 1750Hz tone is put out from Pin 4 of IC3 and fed to the mic amplifier circuit through R77, level adjust trimmer.

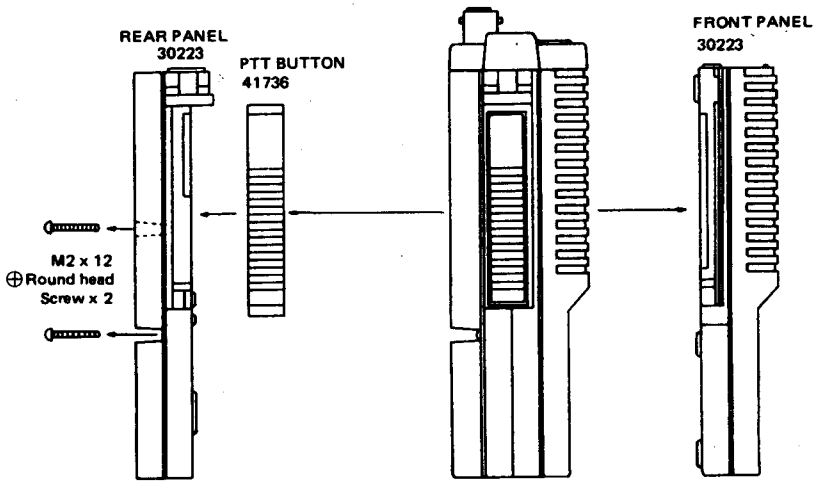
MAIN UNIT SIDE


Thumbwheel Switches
L2 ~ L4 (RX Band-Pass Filter)
FI1 (10.695MHz Crystal Filter)
S1 (PTT Switch)
Tone Generator circuit (IC-2E Only)
IC2 (BA516 AF Power Amp)
IC1 (MC3357 IF Circuit IC)
L7 (Quadrature Coil)
FI2 (455KHz Ceramic Filter)
X1 (10.240MHz 2nd LO Crystal)
R77 (Tone Signal Level Adjust)
Two-Tone Encoder Connector
R71 (Deviation Adjust)

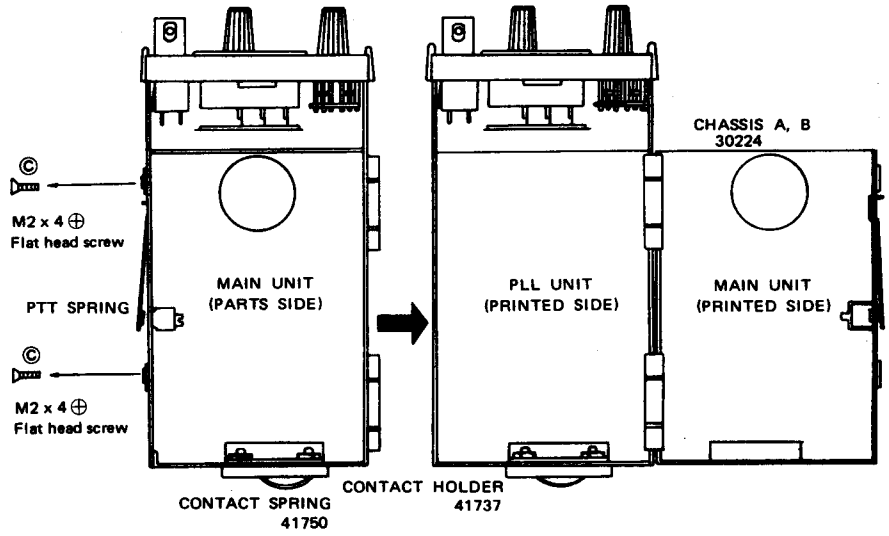
PLL UNIT SIDE


L9 (X4 0KHz Frequency Adjust)
L10 (X5 0KHz Frequency Adjust)
L14 (X5 +5KHz Frequency Adjust)
L13 (X4 +5KHz Frequency Adjust)
X5 (34.85MHz PLL – Duplex LO Crystal)
X4 (35.15MHz PLL + Duplex LO Crystal)
X3 (35.00MHz PLL Simplex LO Crystal)
X2 (32.32625MHz PLL RX LO Crystal)
L11 (X2 +5KHz Frequency Adjust)
L15 · L16 (PLL LO Output Filter)
Thumbwheel Switch Connector
IC1 (TC9123 Programmable Divider)
IC2 (TC5081 Phase Detector)
IC3 (TC5082L Oscillator/Divider)
X1 (5.12MHz Reference Frequency Crystal)
L17 · L18 (RX LO Band-Pass Filter)
S3 RF POWER SWITCH
S1 DUPLEX/SIMPLEX SWITCH
S2 DUPLEX MODE SWITCH
C91 (Trimmer)
C90 (Trimmer)
L8 (X3 0KHz Frequency Adjust)
Q13 (PA 2SC1947)
L12 (X3 +5KHz Frequency Adjust)
L7 (X2 0KHz Frequency Adjust)
C86 (Trimmer)
C85 (Trimmer)
Q12 (Driver 2SC2053)
L21 · L22 (TX Band-Pass Filter)
L3 (VCO Free-Run Frequency Adjust)
VCO Circuit
L19 · L20 (TX Band-Pass Filter)

6 - 2 DISASSEMBLY OF UNITS



To see the printed sides of the PC boards, open the chassis by removing two screws Ⓒ located above and below the PTT spring.

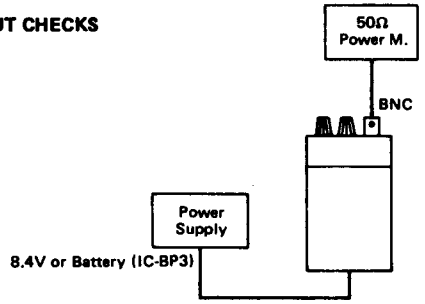


7 - 1 STRUMENTI DI MISURA RICHIESTI PER LA TARATURA

(1) FREQUENCY COUNTER	FREQUENCY RANGE	0.1 - 160MHz
	ACCURACY	BETTER THAN ±1 ppm
	SENSITIVITY	100mV or BETTER
(2) SIGNAL GENERATOR	FREQUENCY RANGE	0.1MHz - 160MHz
	OUTPUT VOLTAGE	−20 - 90dB (0dB = 1μV)
(3) MULTIMETER	50KΩ/Volt or better	
(4) AC MILLIVOLTMETER	MEASURING RANGE	10mV - 2V
(5) RF VOLTMETER	FREQUENCY RANGE	0.1 - 160MHz
	MEASURING RANGE	0.01 - 10V
(6) RF WATTMETER (Terminated Type)	MEASURING RANGE	5 Watts
	FREQUENCY RANGE	140 - 160MHz
	IMPEDANCE	50 OHMS
	SWR	LESS THAN 1.1
(7) AF OSCILLATOR	OUTPUT FREQUENCY	200 - 3000Hz
	OUTPUT VOLTAGE	0 - 100mV
	DISTORTION	LESS THAN 0.1%
(8) OSCILLOSCOPE	FREQUENCY RANGE	DC – 10MHz
	MEASURING RANGE	0.01 – 10V
(9) FM DEVIATION METER	FREQUENCY RANGE	140 ~ 160MHz
	MEASURING RANGE	0 ~ ±10KHz
(10) DIRECTIONAL COUPLER	FREQUENCY RANGE	140 ~ 160MHz
(11) AMPERMETER	MEASURING RANGE	0 ~ 1A DC
(12) DUMMY LOAD OR EXTERNAL SPEAKER	IMPEDANCE	8 OHMS
(13) VOLTAGE REGULATED POWER SUPPLY	OUTPUT VOLTAGE	5 ~ 11V DC (Adjustable)
	CAPACITY	1A OR MORE

7 - 2 PRELIMINARY CHECKS

7 - 2 - 1 TRANSMITTER OUTPUT CHECKS



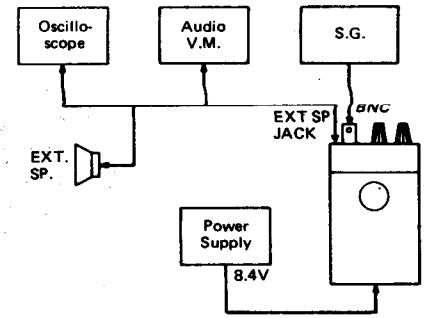
1. Connect a 50 ohm RF wattmeter to the ANT connector.
2. Setting the IC-2A frequency 147.000MHz (IC-2E : 145.000MHz) and key the transmitter. Observe the RF power OUTPUT.
3. Power output should be 1.5 watts at rated input voltage.

7 - 2 - 2 RECEIVER CHECKS

Make all checks at 8.4V DC

1. Settings of controls and switches

Power switch	ON
Squelch Control	Minimum position
Dup/Simp Switch	Simp
Frequency	147.000MHz
	(IC-2E : 145.000MHz)



2. Connect an AF voltmeter to the SP jack and set the SQL control fully counterclockwise.
3. Connect the RF output of a VHF signal generator to the ANT connector.
4. Adjust the VOL control and the AF voltmeter range.
   Adjust the VOL control for a full scale reading on the AF voltmeter. Don't change the VOL control setting after this adjustment.
5. Set the signal generator to the receiving frequency and adjust the output level of the signal generator until the AF voltmeter shows a 20dB decrease in reading.
6. The signal/generator output voltage at this point is the 20dB quieting sensitivity.

7 - 3 PREPARATION AND PROCEDURE BEFORE SERVICING

1. Confirm defective operation and check to make sure setup or external sources are not the cause of the problem.
2. Proper tools and measuring instruments are required for repair and adjustment. Don't try to repair or modify without them.
3. Remove the transceiver case as shown on Page 6 - 1. Use a screw driver that fits the screw.
4. IC-2AT has two-tone oscillator at the front panel with wires connecting it to the main board. If you force the cover removing it, a wire could be broken.
5. To open the hinge chassis remove the two screws as shown on Page 6 - 2.
6. Attach an 8.0 ~ 11.0V DC external power source to the battery clip or screw. Be sure to check the polarity.
7. In the case of a transmission problem, a dummy load should be connected to the antenna connector. In the case of a receiving problem, an antenna or signal generator is connected to the antenna connector. Be careful not to transmit into the signal generator.
8. Recheck for the suspected malfunction with the power switch on.

9. Check the defective circuit and measure the DC voltages of the collector, base and emitter of each transistor.

10. When checking a transmission problem, it is convenient to short circuit an accessory mic connector plug and insert it, turning on the transmitter.

7-4 HOW TO CHECK

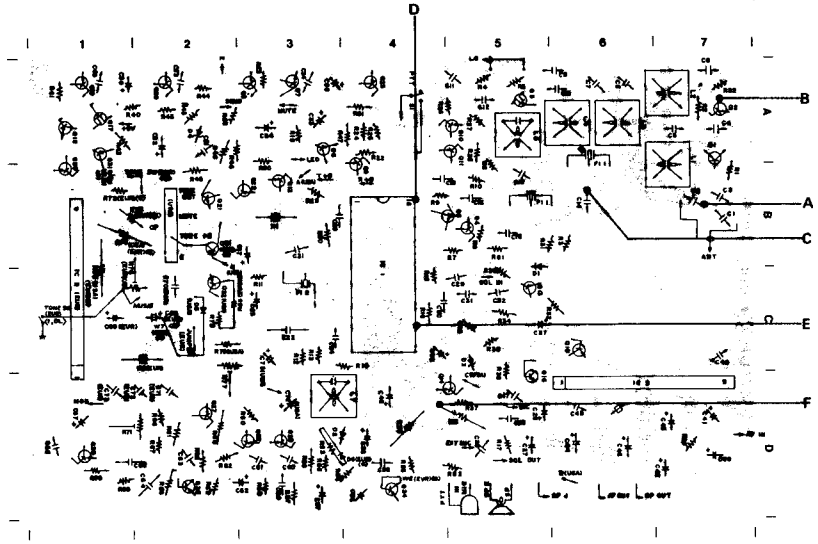
7-4-1 RECEIVE

1. Check the frequency of P.L.L. unit when you are unable to receive with a strong signal present and noise present when turning up the AF volume.

2. When no noise is present at the speaker, check audio frequency amplifier or 5V regulator first.

3. Inject RF through a 0.01μF capacitor from an FM signal generator modulated with 1KHz audio modulation (FM), to points (A) through (D) in order, check for receiver output.
   (A) = 146.000MHz (IC-2E : 145.000MHz)
   (B) = 146.000MHz (IC-2E : 145.000MHz)
   (C) = 10.695MHz
   (D) = 10.695MHz

4. Check (E) and (F) with an oscilloscope, for demodulated output in the audio frequency range.

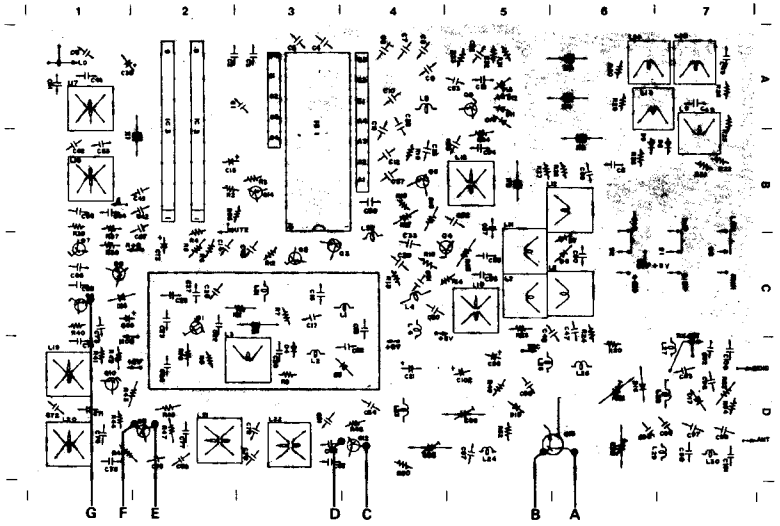


7-4-2 TRANSMITTER

1. Check (A) through (G) in order with RF voltmeter.

2. When the transmitter output is low, check regulated power supply voltage first, do not turn coil trimmers.

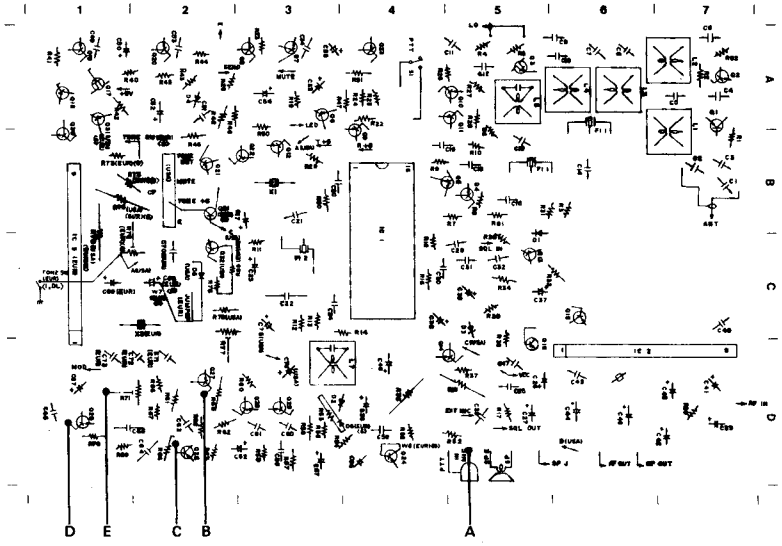
3. When transmission is normal, RF is present and it is not possible to measure the DC voltage accurately with a voltmeter.



7-4-3 MODULATION

1. Put a signal into the EXT MIC connector (1KHz 40mV) with an AF oscillator or an external mic.

2. Check the AF voltages (A) through (E) in order with an oscilloscope.



7-4-4 P.L.L.

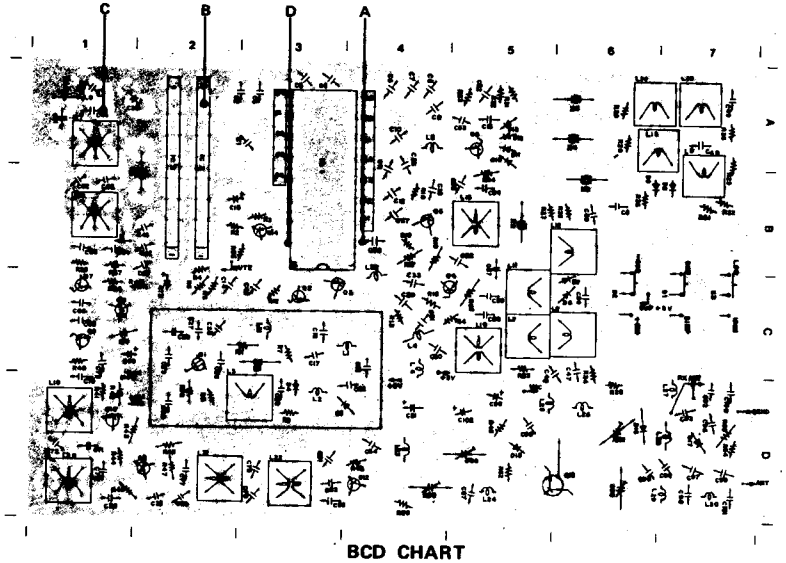
1. Check (A) with an oscilloscope. A lock failure is indicated by an instability or absence of the wave form. Check as follows:

2. Check the Frequency of the master oscillator (10.24MHz). If a 5KHz 5Vp-p squarewave is not observed at (B), measure DC voltage on Pin 5 of IC3 if no oscillation.

3. Wave measure the output of (C) and (D) with an oscilloscope.

4. Measure DC voltage of Q1, Q2, Q3, Q4 and Q5.

5. If the transmit or receive frequency differs from the display, check the voltage of A1 to C4 on the IC1 (BCD control lines from top switches).



BCD CHART

	10KHz				100KHz				1MHz			
INPUT BCD	1 A1	2 A2	4 A3	8 A4	1 B1	2 B2	4 B3	8 B4	1 C1	2 C2	4 C3	8 C4
FREQUENCY 144.00	L	L	L	L	L	L	L	L	L	L	H	L
144.01	H	L	L	L	L	L	L	L	L	L	H	L
144.02	L	H	L	L	L	L	L	L	L	L	H	L
144.03	H	H	L	L	L	L	L	L	L	L	H	L
⋮												
145.98	L	L	L	H	H	L	L	H	H	L	H	L
145.99	H	L	L	H	H	L	L	H	H	L	H	L
146.00	L	L	L	L	L	L	L	L	L	H	H	L
146.01	H	L	L	L	L	L	L	L	L	H	H	L
146.11	H	L	L	L	H	L	L	L	L	H	H	L
146.12	L	H	L	L	H	L	L	L	L	H	H	L
147.00	L	L	L	L	L	L	L	L	H	H	H	L
147.50	L	L	L	L	H	L	H	L	H	H	H	L
147.99	H	L	L	H	H	L	L	H	H	H	H	L

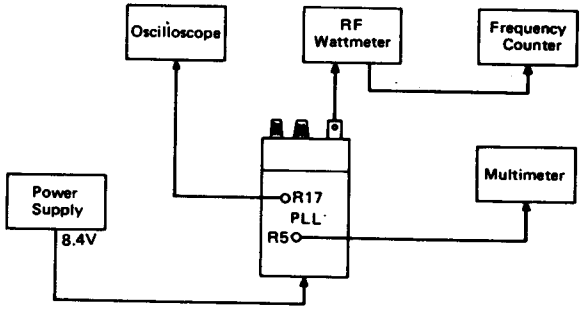
H = 5V L = 0V

7-5 BASIC ALIGNMENT PROCEDURE

7-5-1 P.L.L. CIRCUIT

A. Lock Adjustment

1. Connect the measuring instrument and set the control knobs as follows:
   - Connect an oscilloscope (10MHz band width) to R17.
   - Connect voltmeter between R5 and ground.
   - Set thumbwheel switches to 144.00MHz.



2. Procedure

When the circuit is operating normally, adjust coil L3. The P.L.L. will lock.
- Adjust the coil of L3, and the voltage of R5 varies between 0 ~ 5V, and P.L.L. should lock.
- Adjust L3 for 1V after lock.

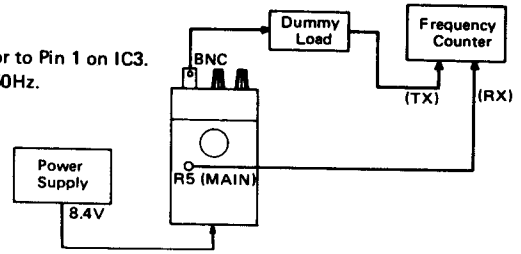
Next, in Receive adjust L16 for maximum voltage (P-P value) on the oscilloscope and then during transmission adjust L15 to maximum. Repeat adjustment of L15, L16 several times. After that, confirm the following voltage of R5 (both transmission and receiving) 1V ±0.3V at 144MHz, and that the voltage of R17 (both transmission and receiving) is over 3Vp-p (over operating range of the radio). If the P.L.L. won't lock, check these voltages: R+5V, T+5V, 5V constant, and the P.L.L. LO and reference frequency oscillator for oscillation. Connect a counter to R37, and check the oscillation frequency of the V.C.O. during transmission.

If unlocked check that L3 can be adjusted as follows:

- Adjust L3 to 65MHz when the voltage of R5 is 0V.
- Adjust L3 to 70MHz when the voltage of R5 is 5V.

B. Reference Frequency Oscillator Check

1. Connect a counter through a capacitor to Pin 1 on IC3.
2. Confirm frequency is: 5.12MHz ±250Hz.



C. P.L.L. LO Frequency Adjustment

1. Connection of the measuring instruments and the setting of knob.
   - When adjusting the receiving frequency, connect the counter to R5 of the MAIN unit through a capacitor. After power adjustment, loosely couple the set to a counter with capability of more than 150MHz (with dummy load connected), so that the transmitting frequency can be obtained.
   - Set thumbwheel switches of the set to 146.000MHz (IC-2E : 145.000MHz).

2. First, adjust +5KHz and turn to 0KHz. Then check again, because these adjustments interact.

MODE	RX.	SIM/TX.	+600 DUP	−600 DUP
5KHz Adj. FREQ.	L 11	L 12	L 13	L 14
	135.310	146.005	146.605	145.405
	IC-2E:134.310	145.005	145.605	144.405
0KHz Adj. FREQ.	L 7	L 8	L 9	L 10
	135.305	146.000	146.600	145.400
	IC-2E:134.305	145.000	145.600	144.400

3. Confirmation
Check each frequency (including band-edge):
All frequencies should be within ±500Hz.

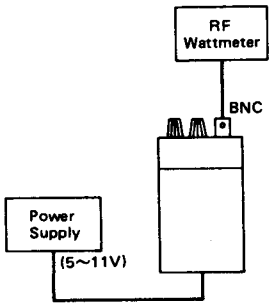
7-5-2 TRANSMISSION

A. Power Adjustment

1. Connection of measuring instruments and setting of the knobs.
   - Connect ANT to 50 ohm power meter.
   - Connect a voltmeter and variable power supply to the set.
   CAUTION: Applying over 10.8V can damage the P.A. transistor.
   - Thumbwheel SW of 2A/2AT to be 146.00MHz.
   Duplex SW shall be in the SIMP position.
   - Power SW shall be HI.

2. Procedure
   - Adjust L19 through L22 of the PLL unit for maximum RF power output while pushing PTT SW.
   - Set the RF Power switch at LOW, and adjust C86 for maximum RF output.
   - Set the RF Power switch at HIGH, and adjust C85 for maximum RF output.
   - Repeat above adjustment procedures until no readjustment of C85 and C86 is required when the RF Power is switched.
   - Set RF Power switch at HIGH, and adjust C90 and C91 for maximum RF output.
   - If the total current drain exceeds 500mA, adjust C91 to set the current at 500mA.
   - In the HIGH power mode, readjust L21 and L22 for maximum RF output.

3. Confirmation
   High Power (rated voltage)
   More than 1.5W, less than 500mA current drain.
   From 144 to 147.99MHz (IC-2E : 145.99MHz) - retune to bring band edge power to minimum if necessary.
   Low Power (rated voltage)
   150mW (+100% −50%), less than 330mA current drain.
   High Power at 7.2V over 1W.
   10.8V over 2.3W.
   No abnormality in operation should be found if the supply voltage is varied from 5.5V to 10.8V.



B. Modulation Adjustment

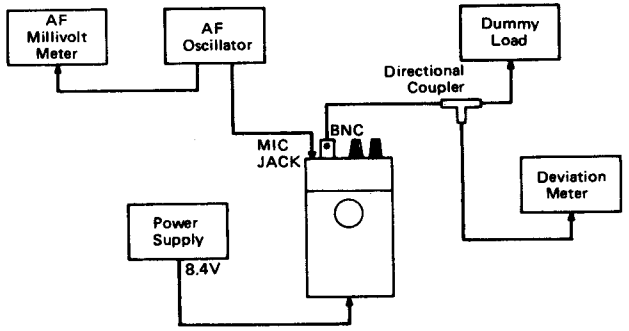
1. Connecting the measuring instrument and the settings of the controls.

   Connect ANT Connector to a deviation meter with a directional coupler or attenuator.

   Deviation meter filter shall be a High Pass Filter 50Hz, L.P.F. 20KHz. De-emphasis OFF.

   - Set thumbwheel SW to 146MHz (IC-2E : 145MHz).
   - Set SIMP/DUP to SIMP.
   - Set Power SW to HI.
   - Connect an AF oscillator, with a millivoltmeter in parallel, to the mic input.

   Insert a switch in series to allow on/off TX switching.



2. Procedure
   Mic input shall be 1KHz 40mV RMS. During TX, adjust R71 on the main unit for 5KHz deviation.

3. Modulation check
   Maximum deviation: With 1KHz 40mV shall be 5KHz ±10%.

   Modulation sensitivity: Mic input voltage 4mV ±3dB at 1KHz. Deviation should be 3.5KHz.

   S/N Ratio:
   Connect the output of the deviation meter to a millivoltmeter. With no audio input to the mic input, take the voltmeter reading. Now insert 1KHz 40mV audio into the mic connector. Take the voltmeter reading. The ratio should be greater than 40dB.

4. Spurious Transmission
   Connect spectrum analyzer with appropriate attenuation. Confirm nearby random spurious signals below fundamental frequency less than −60dB.

   Measure the harmonic wave output, adjust RF-ATT until noise level just appears.

   Should be less than −60dB below the fundamental frequency.

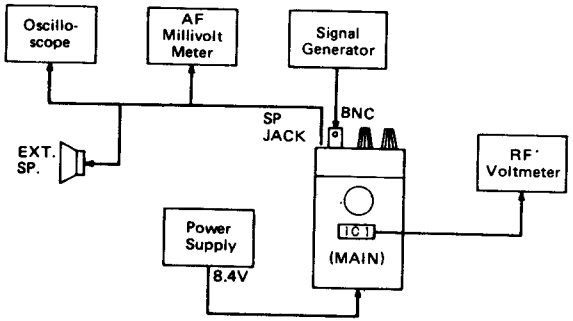
7-5-3 RECEIVER

A. LO Output Adjustment

- Adjust thumbwheel SW to 146MHz (IC-2E : 145MHz). Adjust L17, L18, for maximum output on an RF voltmeter attached to the source of Q3 in the main unit. Output voltage should be about 200mV.

B. RF IF DET Coil Adjustment.

1. The connecting point of measuring instrument and the setting of the knob.
   - Set thumbwheel to 146MHz (IC-2E : 145MHz).
   - Connect antenna to signal generator.
   - Connect SP terminal to EXT SP and AF millivoltmeter.



2. Procedure

   Set RF voltage meter (minimum range) to Pin 16 on IC1 in the IF, adjust L1 through L5 maximum output while setting the input from the signal generator as low as possible. Then vary the input frequency from the signal generator ±10KHz. Check if rippling (change in output level) occurs. If ripple is over 3dB, readjust L5.

   Set signal generator output to −80dBm to −90dBm and deviation to 3.5KHz. Set signal generator frequency to speaker output maximum. After that, adjust L7 for maximum output.

3. Confirmation

   Sensitivity should be less than −8dBμ for 20dB quieting.

C. 2nd LO Frequency Check

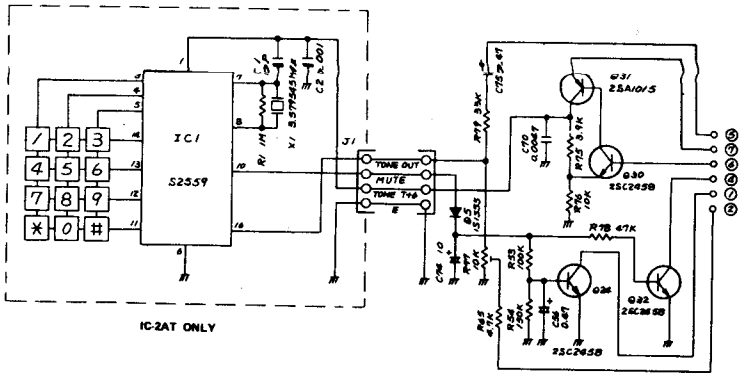
Connect a 10.24MHz amplifier to the counter, check the frequency of X1 (2nd OSC) with a loose couple. It should be: 10.240MHz ±400Hz.

D. Receiver Spurious Response

Connect a speaker and millivoltmeter to the EXT SP. Connect a 50 ohm dummy load to the antenna terminal. All RX spurious should be supressed less than 3dB, over entire frequency range.

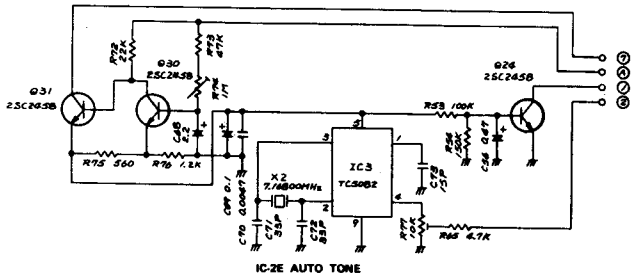
E. Receive Audio Output

Connect to the EXP SP connector a millivoltmeter, oscilloscope, and a distortion meter. To the ANT terminal connect the signal generator and set the signal generator to −80 to −90dBm and deviation to 3.5KHz. Turn up AF VOL control. Read the millivoltmeter when the distortion is 10%.



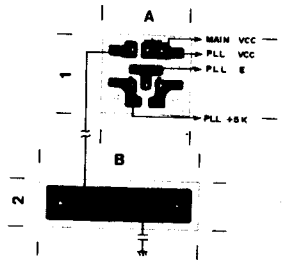
IC-2AT ONLY

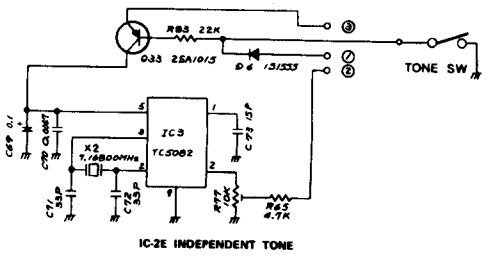
EF UNIT



IC-2E AUTO TONE

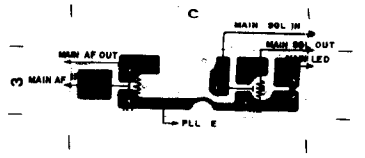
■ SWITCH BOARD





IC-2E INDEPENDENT TONE

■ VR BOARD



SECTION 9 VOLTAGE CHARTS

TRANSISTORS VOLTAGE CHART

• Measuring instrument is a 50KΩ/V multimeter.

UNIT	NO.	TRANSMIT			RECEIVE			REMARKS
		BASE or GATE	COLLECTOR or DRAIN	EMITTER or SOURCE	BASE or GATE	COLLECTOR or DRAIN	EMITTER or SOURCE	
MAIN	Q 1	0	0	GND	0.75	1.9	GND	RF Amp
	Q 2	0	0	0	2.2	5.5	1.9	RF Amp
	Q 3	0	0	0	0	5.4	1.6	1st Mixer
	Q 4	0	0	GND	0.7	0.9	GND	1st IF Amp
	Q 5	0	0	0	1.6	2.2	0.9	1st IF Amp
	Q 6	4.2	4.8	5.0	4.9	0	5.0	T/R Switch
	Q 7	0	0.7	GND	0	0.3	GND	T/R Switch
	Q 8	0.7	0	GND	0.3	4.1	GND	T/R Switch
	Q 9	4.6	0	5.0	4.2	4.9	5.0	T/R Switch
	Q10	0	7.8	0	4.9	7.8	4.4	T/R Switch
	Q11	7.8	0	8.4	7.8	5.6	8.4	T/R Switch
	Q12	4.8	7.9	4.2	0	8.4	0	
	Q13	0	0.5	0	3.7	1.5/0	2.8/3.4	Noise Detector SQL CLOSED/SQL OPENED
	Q14	0.6	0	GND	0.6/0	0/8.2	GND	Squelch Control
	Q15	0	7.8	0	0/8.2	7.8	0/7.6	Squelch Control
	Q16	7.8	0	8.4	7.8	7.6/0	8.4	T/R Switch
	Q17	0.6	8.4	2.0	0.5	8.4	2.0	Regulator
	Q18	8.2	5.0	8.4	8.4	5.0	8.4	Regulator
	Q19	0.6	8.2	GND	0.5	8.4	GND	Regulator
	Q20	0.6	0.6	GND	0.6	0.5	GND	
	Q21	5.7	3.4	5.0	5.8	0	5.0	Indicator Control
	Q22	3.4	4.0	4.2	0	0	0	Indicator Control
	Q23	4.8	3.8	3.9	3.2	1.3	5.0	
	Q24	0.6	0	GND	0	4.9	GND	Mic Amp Mute Cont.
	Q25	2.4	4.2	2.0	0	0	0	Mic Amp
	Q26	2.6	3.6	2.0	0	0	0	Mic Amp
	Q27	3.6	2.6	4.1	0	0	0	Mic Amp
	Q28	0.6	2.0	GND	0	0	GND	Limiter
	Q29	2.1	4.2	1.9	0	0	0	Low Pass Filter
	Q30	0/4.9	4.4/7.7	2.6/4.9	0/0	0/7.8	0/0	T/R Switch IC-2A/AT only
	Q31	4.4/8.3	8.4/6.1	4.0/8.4	0/8.4	8.4/0	0/8.4	T/R Switch IC-2A/AT only
	Q32	0	0.6	GND	0	0.6	GND	IC-2A 2AT only
	Q33	3.6	4.2	4.2	0	0	0	IC-2E only
PLL	Q 1	0	4.0	0.8	0	4.0	0.75	VCO, FM Mod.
	Q 2	0.7	1.0	GND	0.7	1.0	GND	Buffer Amp
	Q 3	1.6	2.9	1.0	1.6	2.9	1.0	Buffer Amp
	Q 4	0.7	0.7	GND	0.7	0.7	GND	PLL Mixer
	Q 5	1.4	3.4	0.9	1.4	3.4	0.9	Level Converter
	Q 6	1.3	4.9	0.8	1.3	4.9	0.8	Multiplier
	Q 7	0	0	1.5	2.0	4.4	1.7	Multiplier
	Q 8	0.5	1.5	GND	0.5	1.7	GND	Buffer Amp
	Q 9	1.8	4.4	1.5	0	0	1.7	Multiplier
	Q10	0	1.2	GND	0.7	0	GND	
	Q11	1.1	8.0	0.5	0	8.4	0	Buffer Amp
	Q12	0.55	8.4	0.1	0	8.4	0	Driver
	Q13	1.2	8.4	GND	0	8.4	GND	Power Amp
	Q14	4.6	0	5.0	4.6	0	5.0	

IC'S VOLTAGE CHART

• Measuring instrument is a 50KΩ/V multimeter.

IN TRANSMIT MODE

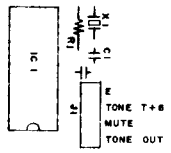
UNIT	IC No.	PIN No. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	REMARKS
MAIN	IC1	0	0	0	0	0	0	0	0	0	0	0	GND	0	0	GND	0			
MAIN	IC2	0	0	0	0	GND	0	0	0	0										
MAIN	IC3	0.8	1.4	1.6	1.8	4.0	2.0	2.0	2.0	GND										IC-2E only
PLL	IC1	5.0	1.0	0	0	0	0	0	0	0	0	4.4	0	4.4	0	0	0	0	GND	f = 145MHz
PLL	IC2	0	4.4	1.2	5.0	5.0	0	0	2.4	GND										
PLL	IC3	0.9	1.4	1.8	0	5.0	0	2.4	2.4	GND										
TOUCH TONE	IC1	6.1	5.7	6.1	6.1	6.1	GND	0	6.1	6.1	0	0	0	0	0	4.4	0			IC-2AT only

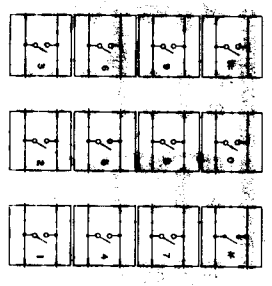
IN RECEIVE MODE

UNIT	IC No.	PIN No. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	REMARKS
MAIN	IC1	4.2	5.0	5.3	5.6	0.9	0.9	1.1	5.6	2.9	2.0	2.1	GND	5.1	0	GND	2.0			
MAIN	IC2	6.1	4.3	7.6	3.6	GND	3.6	3.6	3.4	3.4										SQL OPEN
MAIN	IC3	0	0	0	0	0	0	0	0	GND										IC-2E only
PLL	IC1	5.6	1.0	0	0	0	0	0	0	0	0	4.4	0	4.4	0	0	0	0	GND	f = 145MHz
PLL	IC2	0	4.4	1.2	5.0	5.0	0	0	2.4	GND										
PLL	IC3	0.9	1.4	1.8	0	5.0	0	2.4	2.4	GND										
TOUCH TONE	IC1	0	0	0	0	0	GND	0	0	0	0	0	0	0	0	0	0			IC-2AT only

TOUCH TONE UNIT

• IC-2AT ONLY





[TOUCH TONE UNIT] (IC-2AT only)

REF. NO.	DESCRIPTION	PART NO.	
IC1	IC	S2559	
X1	Crystal	3.579545MHz HC/43U	
R1	Resistor	1M	R10
C1	Ceramic	10P	50V
C2	Ceramic	0.001	50V
J1	Connector	3024-04CH	
	Key Switch	KHG	
B1	PC Board	8-416C	

SECTION II SPECIFICATIONS

GENERAL

Number of Semi-conductors	Transistors 43 (42) <41> FET 3 IC 5 [6] (6) Diodes 21 (20)
Frequency Coverage	144.000 ~ 147.995MHz: IC-2Au, IC-2Ao, IC-2AT, IC-2EI 144.000 ~ 145.995MHz: IC-2EDL
Frequency resolution	5KHz steps 800 channels or 400 channels
Frequency Control	Digital PLL synthesizer, with thumb wheel switch
Frequency stability	Within ±1.5KHz
Usable Temperature	−10°C ~ 60°C (14°F ~ 140°F)
Antenna impedance	50 ohms unbalanced
Power supply requirement	DC 8.4V; with attendant power pack IC-BP3, DC 6 ~ 12V negative ground is acceptable
Current drain at 8.4V	Transmitting HIGH : 1.5W Approx. 550mA LOW : 0.15W Approx. 220mA Receiving At max audio output Approx. 130mA Squelched Approx. 20mA
Dimensions	116.5mm (H) x 65mm (W) x 35mm (D) Without power pack Attendant power pack, IC-BP3 49mm (H) x 65mm (W) x 35mm (D)
Weight	470g [490g] including power pack, IC-BP3 and flexible antenna

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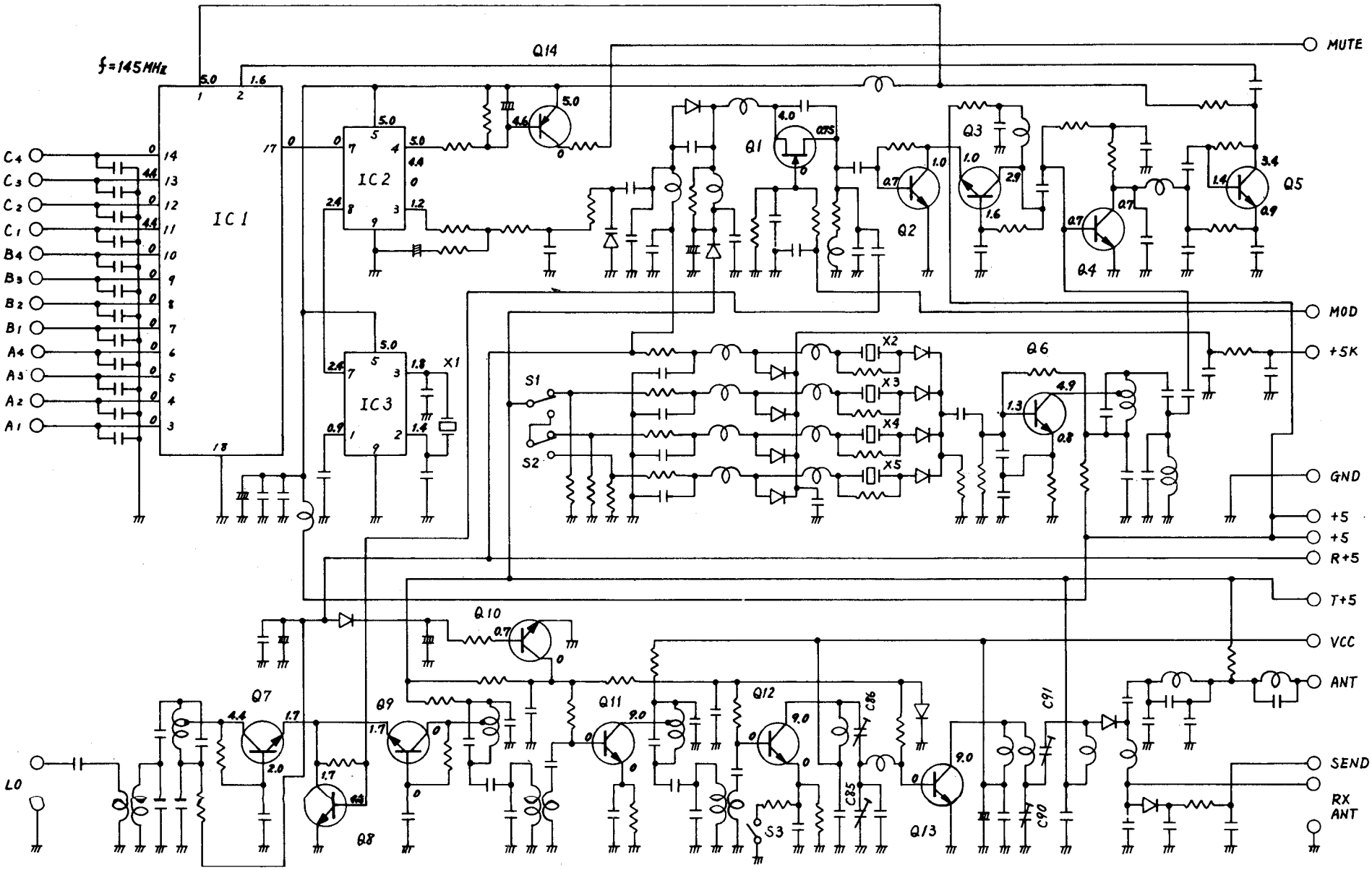
Your IC-2A/AT/E has been tested very carefully at the factory before shipping. The chart below has been designed to help you correct any problems which are not equipment malfunctions. If you are not able to locate the problem and/or solve it through use of this chart, please contact your dealer or ICOM distributor for assistance.

Problem	Possible Cause	Solution
1. Power does not come ON when the switch is turned.	Bad connection of the power pack.	Check the connection of the power pack and correct any problems.
	Reverse polarity of the battery (when using IC-BP4)	Make sure of the polarity of each battery and replace them into the pack.
	The battery has been exhausted.	Replace the battery with a new one or recharge it.
2. No sound comes from the speaker.	VOLUME CONTROL knob is completely counterclockwise.	Turn the knob clockwise to a suitable level.
	The unit is in the transmit mode, by the PTT switch.	Put the unit in the receive mode.
2. No sound comes from the speaker.	SQUELCH setting is turned too far clockwise.	Turn the SQUELCH CONTROL counterclockwise until noise can be heard and reset it just below the threshold.
	External speaker (or earphone) is in use.	Check if the external speaker plug is inserted properly or if the external speaker cable is cut.
	The battery has been exhausted.	Replace the battery with a new one or recharge it.
3. Sensitivity is low and only strong signals are audible.	Bad connection of the flexible antenna.	Check the connection of the antenna and correct any problems.
	The antenna feed line is cut or shorted. (When using an external antenna.)	Check the feed line and correct any improper condition.
4. No or low RF output.	RF Power switch is set at the Low position.	Set the RF Power switch to the High position.
	The battery has been exhausted.	Replace the battery with a new one or recharge it.
	The antenna feed line is cut or shorted.	Check the antenna feed line and correct any problems.
5. No modulation. (When using external microphone.)	Bad connection of the MIC connector.	Check the connection of the MIC connector and correct any problems.
	The MIC cable is cut.	Repair the disconnected or cut wire.
6. The receive mode functions properly and your signals are transmitted, but you are unable to make contact with another station. (When desiring DUPPLEX mode.)	The DUPLEX/SIMPLEX Switch is in the SIMP position.	Set the DUPLEX/SIMPLEX Switch in the DUP position, and the DUPLEX MODE Switch in +600 or −600 position according to repeater input/output frequency.
	Improper input/output frequency of the repeater.	
(When desiring, SIMPLEX mode.)	The DUPLEX/SIMPLEX Switch is in the DUP position.	Set the DUPLEX/SIMPLEX Switch in the SIMP position

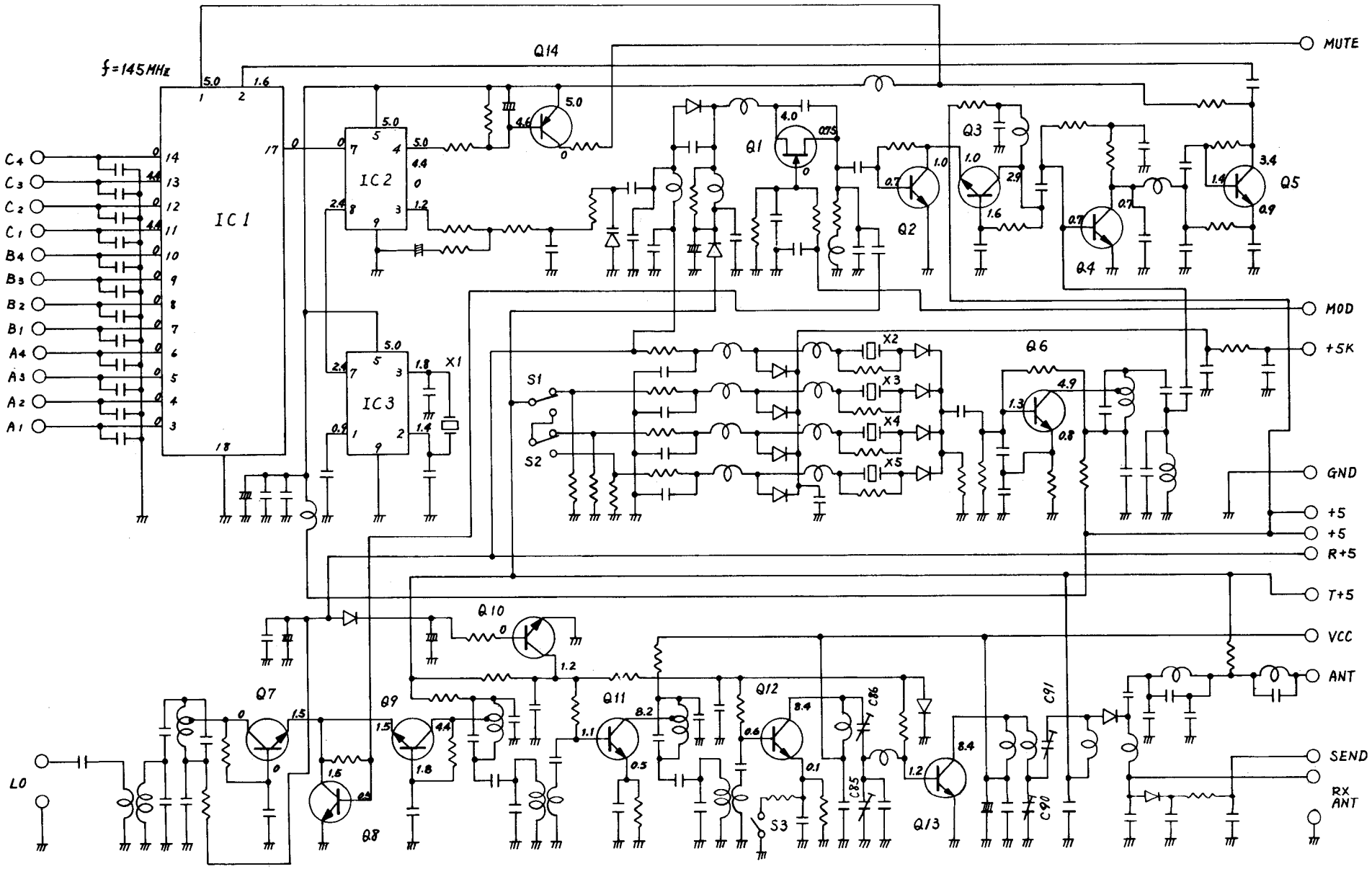
PLL UNIT VOLTAGE CHART (RECEIVE)

VALORI DI TENSIONE SUL CIRCUITO PLL IN RICEZIONE



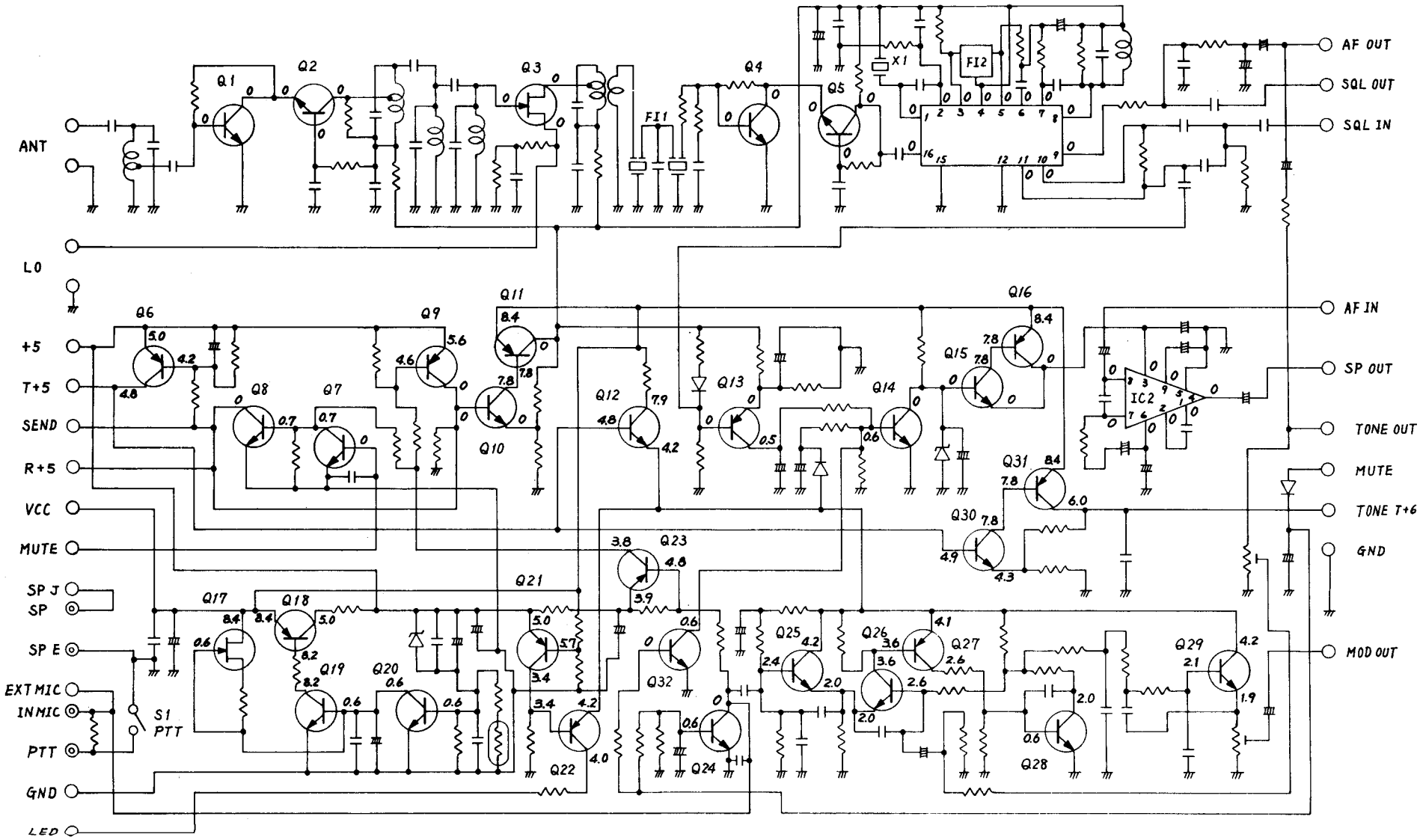
PLL UNIT VOLTAGE CHART (TRANSMIT)

VALORI DI TENSIONE SUL CIRCUITO PLL IN TRASMISSIONE



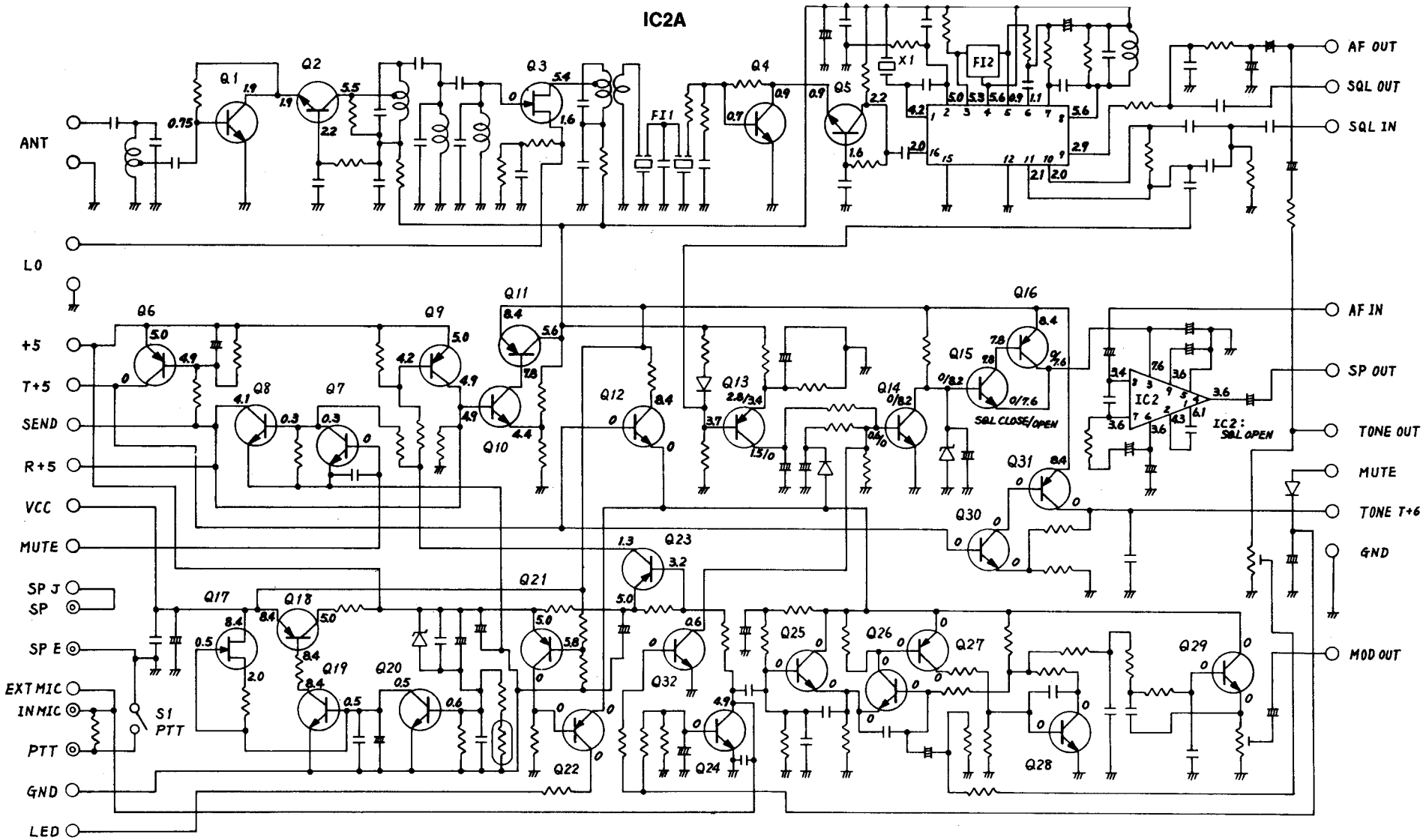
IC-2A MAIN UNIT VOLTAGE CHART (TRANSMIT)

VALORI DI TENSIONE SUL CIRCUITO PRINCIPALE (IN TRASMISSIONE) IC2A



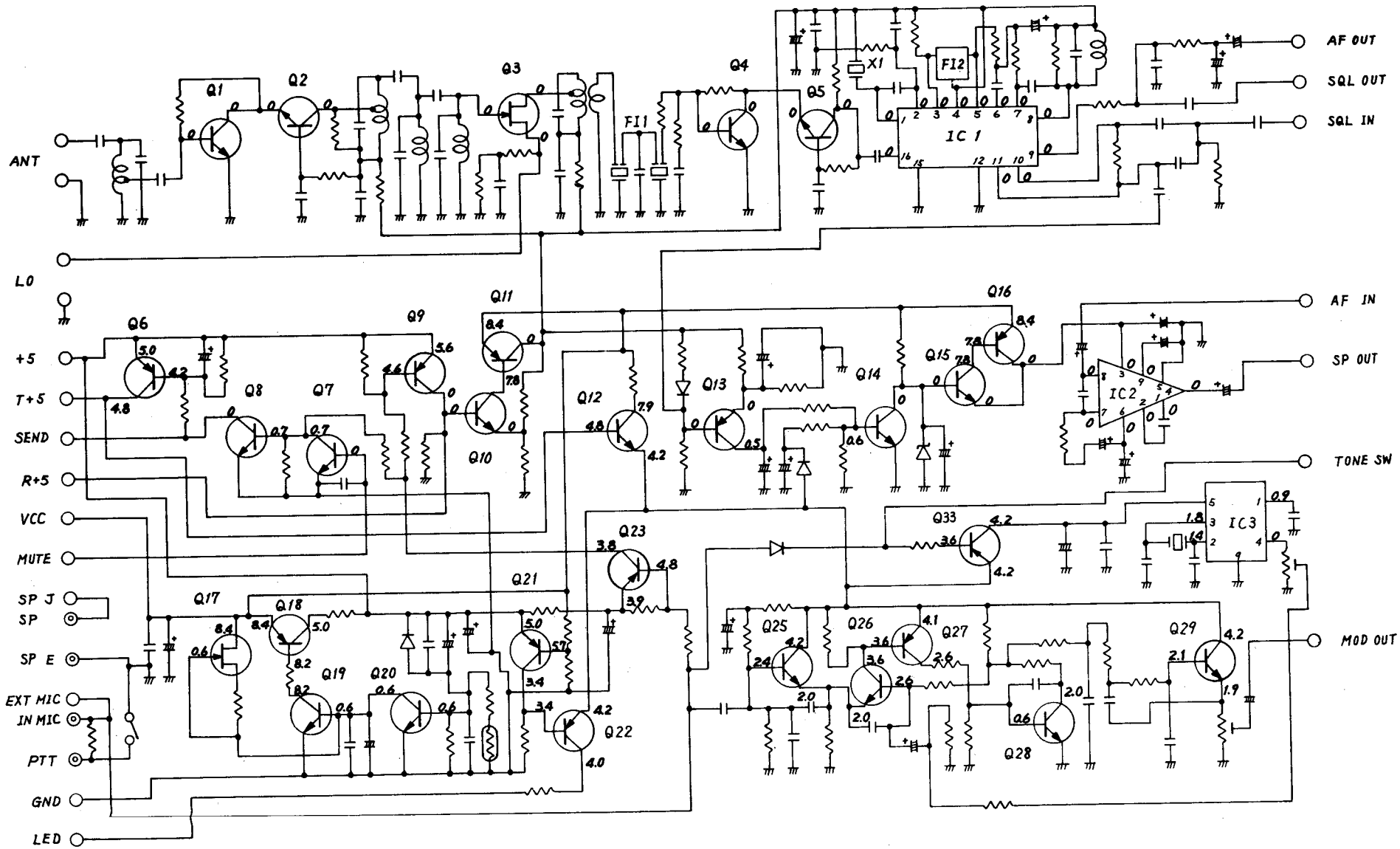
IC-2A MAIN UNIT VOLTAGE CHART (TRANSMIT)

VALORI DI TENSIONE SUL CIRCUITO PRINCIPALE IN TRASMISSIONE



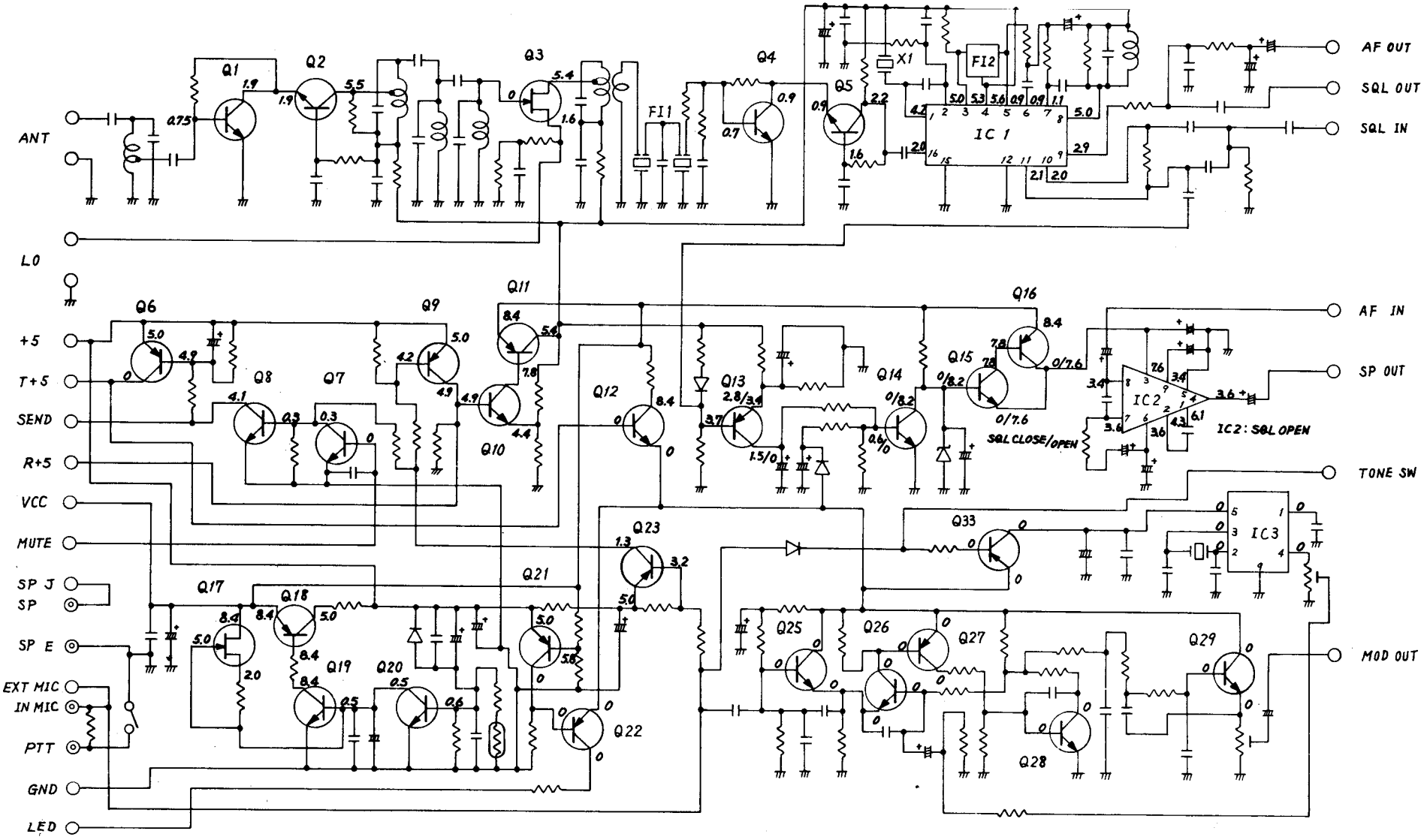
IC-2E MAIN UNIT VOLTAGE CHART (TRANSMIT)

VALORI DI TENSIONE SUL CIRCUITO PRINCIPALE (IN TRASMISSIONE) IC2E



IC-2E MAIN UNIT VOLTAGE CHART (RECEIVE)

VALORI DI TENSIONE SUL CIRCUITO PRINCIPALE (IN RICEZIONE) IC2E



NO POWER ON

TENSIONE DI ALIMENTAZIONE ASSENTE

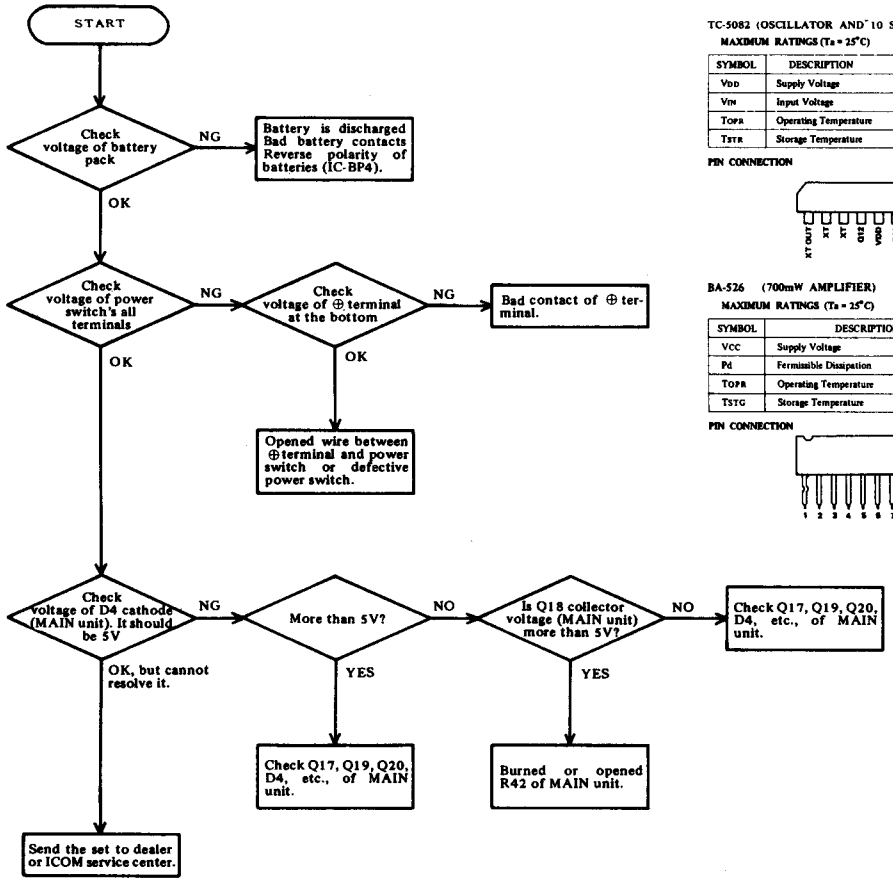

START
Check voltage of battery pack
NG
Battery is discharged Bad battery contacts Reverse polarity of batteries (IC-BP4).
OK
Check voltage of power switch's all terminals
NG
Check voltage of ⊕ terminal at the bottom
NG
Bad contact of ⊕ terminal.
OK
Opened wire between ⊕terminal and power switch or defective power switch.
OK
Check voltage of D4 cathode (MAIN unit). It should be 5V
NG
More than 5V?
NO
Is Q18 collector voltage (MAIN unit) more than 5V?
NO
Check Q17, Q19, Q20, D4, etc., of MAIN unit.
OK, but cannot resolve it.
YES
Check Q17, Q19, Q20, D4, etc., of MAIN unit.
YES
Burned or opened R42 of MAIN unit.
Send the set to dealer or ICOM service center.

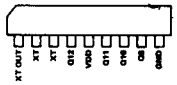
TABELLA DEI GUASTI

TC-5082 (OSCILLATOR AND 10 STAGE DIVIDER)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
VDD	Supply Voltage	10	V
VIN	Input Voltage	−0.3 ~ VDD +0.3	V
TOPR	Operating Temperature	−30 ~ 75	°C
TSTR	Storage Temperature	−55 ~ 125	°C

PIN CONNECTION

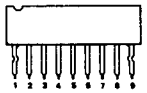


BA-526 (700mW AMPLIFIER)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
VCC	Supply Voltage	9	V
Pd	Fermissible Dissipation	700	mW
TOPR	Operating Temperature	−10 ~ +65	°C
TSTG	Storage Temperature	−30 ~ +125	°C

PIN CONNECTION

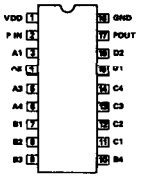


TC-9122P (BCD PROGRAMMABLE COUNTER)

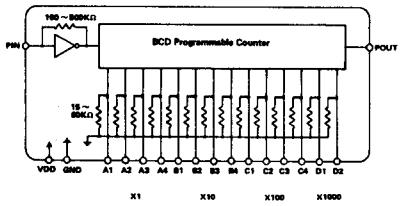
MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
VDD	Supply Voltage	10	V
VIN	Input Voltage	−0.3 ~ VDD +0.3	V
TOPR	Operating Temperature	−30 ~ 75	°C
TSTR	Storage Temperature	−55 ~ 125	°C

PIN CONNECTION



BLOCK DIAGRAM



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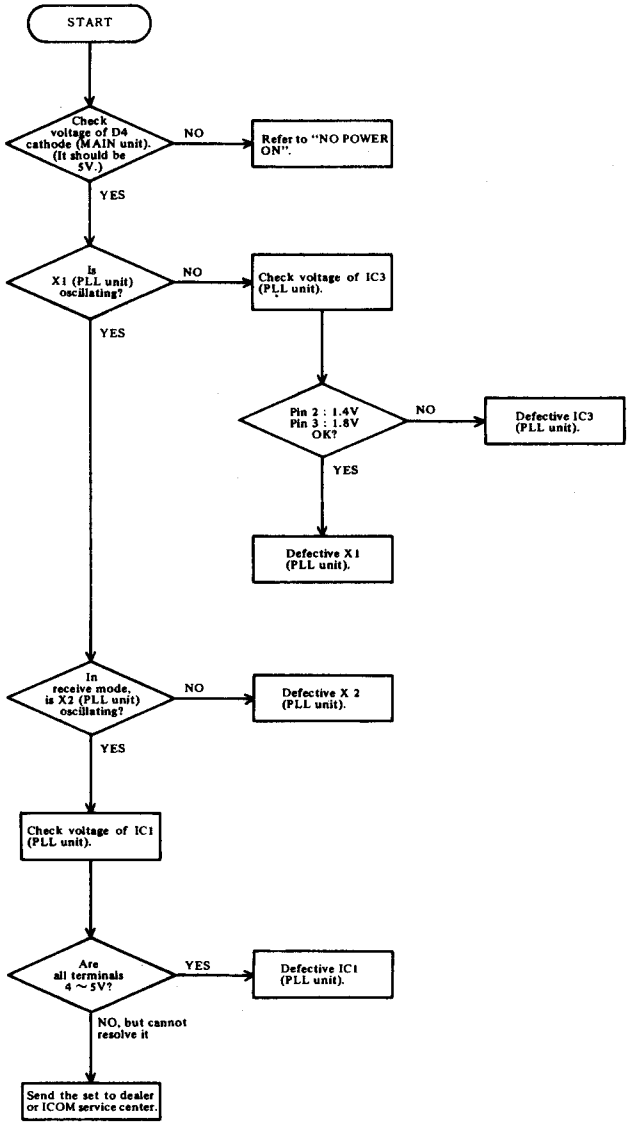
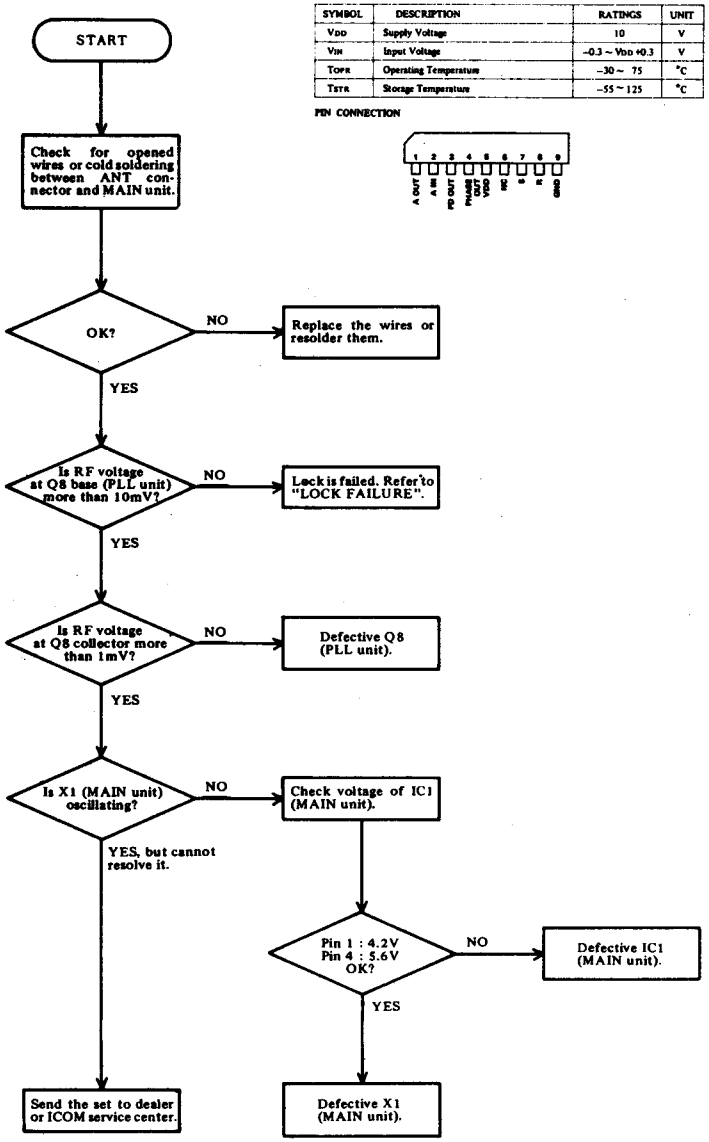
LOCK FAILURE


START
Check voltage of D4 cathode (MAIN unit). (It should be 5V.)
NO
Refer to "NO POWER ON".
YES
Is X1 (PLL unit) oscillating?
NO
Check voltage of IC3 (PLL unit).
YES
Pin 2 : 1.4V Pin 3 : 1.8V OK?
NO
Defective IC3 (PLL unit).
YES
Defective X1 (PLL unit).
In receive mode, is X2 (PLL unit) oscillating?
NO
Defective X 2 (PLL unit).
YES
Check voltage of IC1 (PLL unit).
Are all terminals 4 ~ 5V?
YES
Defective IC1 (PLL unit).
NO, but cannot resolve it
Send the set to dealer or ICOM service center.

NON RICEVE

NO RECEPTION


START
Check for opened wires or cold soldering between ANT connector and MAIN unit.
OK?
NO
Replace the wires or resolder them.
YES
Is RF voltage at Q8 base (PLL unit) more than 10mV?
NO
Lock is failed. Refer to "LOCK FAILURE".
YES
Is RF voltage at Q8 collector more than 1mV?
NO
Defective Q8 (PLL unit).
YES
Is X1 (MAIN unit) oscillating?
NO
Check voltage of IC1 (MAIN unit).
YES, but cannot resolve it.
Pin 1 : 4.2V
Pin 4 : 5.6V
OK?
NO
Defective IC1 (MAIN unit).
YES
Send the set to dealer or ICOM service center.
Defective X1 (MAIN unit).

TC-5081 (PHASE COMPARATOR)

MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{DD}	Supply Voltage	10	V
V_{IN}	Input Voltage	−0.3 ~ V_{DD} +0.3	V
T_{OPR}	Operating Temperature	−30 ~ 75	°C
T_{STR}	Storage Temperature	−55 ~ 125	°C

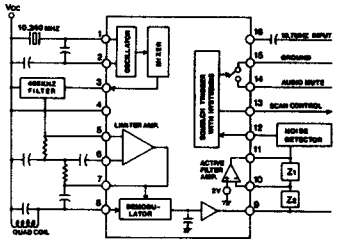
PIN CONNECTION

MC-3357 (LOW POWER FM IF)

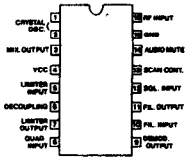
MAXIMUM RATINGS (Ta = 25°C)

SYMBOL	DESCRIPTION	RATINGS	UNIT
V_{CC}	Supply Voltage (MAX)	12	VDC
V_{CC}	Operating Supply Voltage	4 to 8	VDC
V_{IN}	Input Voltage	1.0	VRMS
T_{OPR}	Operating Temperature	−30 ~ +70	°C
T_{STG}	Storage Temperature	−65 ~ +150	°C

BLOCK DIAGRAM

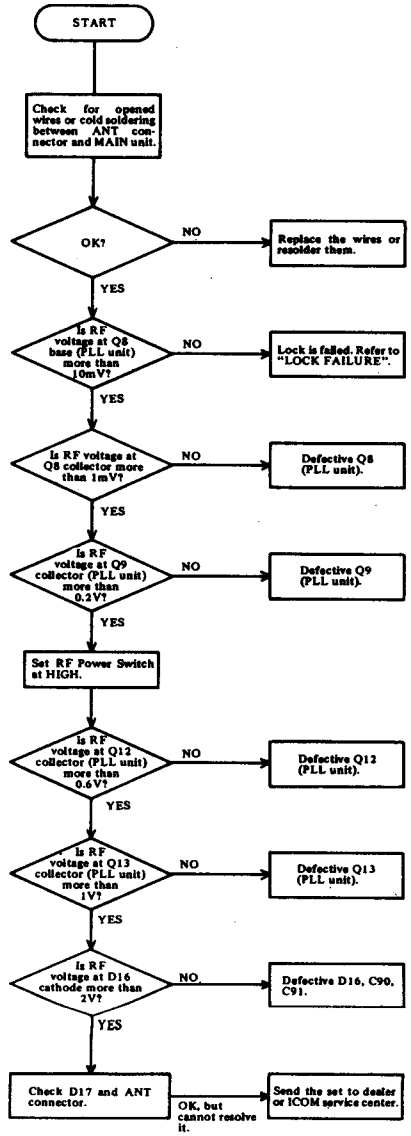


PIN CONNECTION

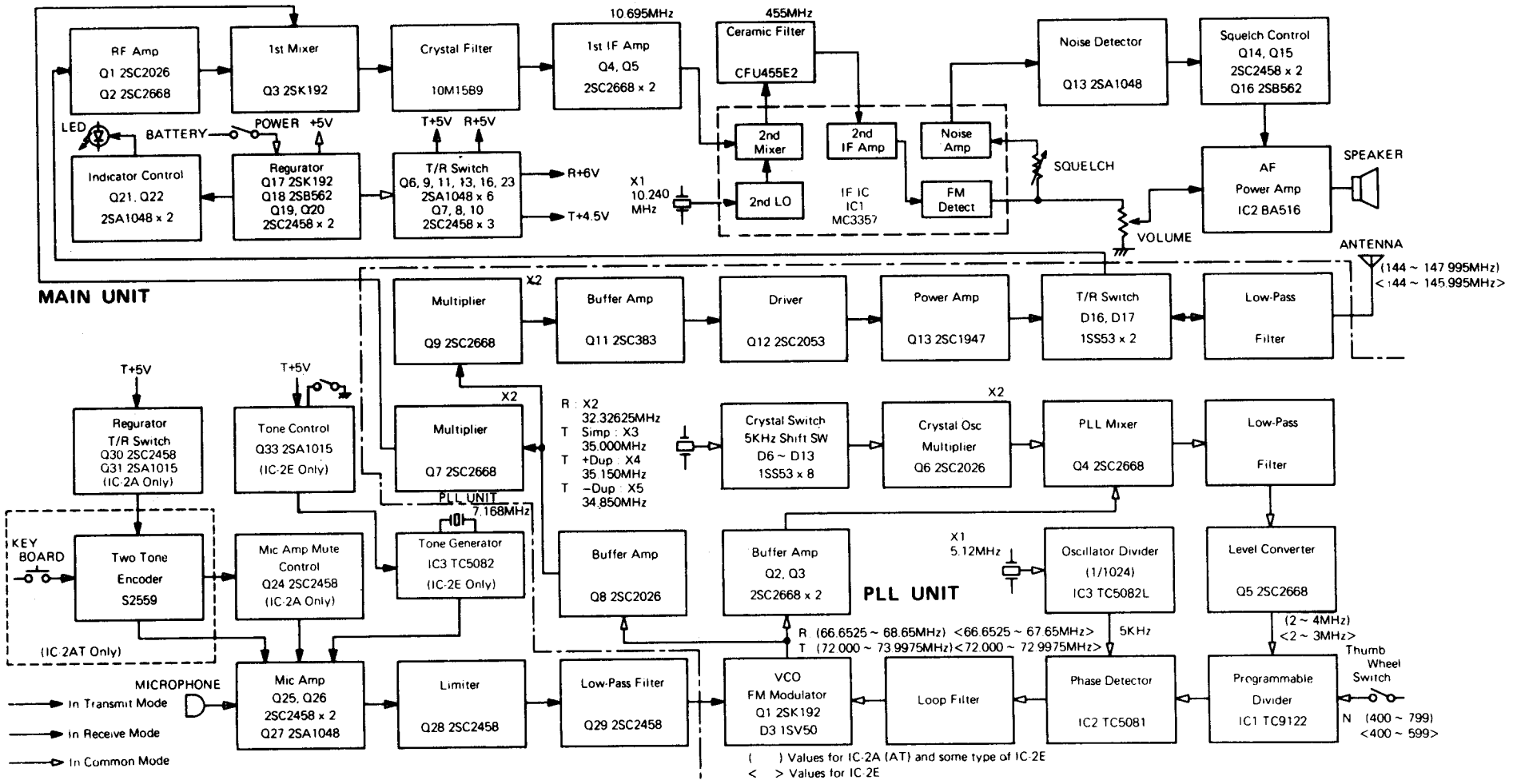


NON TRASMETTE

NO TRANSMIT RF POWER


START
Check for opened wires or cold soldering between ANT connector and MAIN unit.
OK?
NO
Replace the wires or resolder them.
YES
Is RF voltage at Q8 base (PLL unit) more than 10mV?
NO
Lock is failed. Refer to "LOCK FAILURE".
YES
Is RF voltage at Q8 collector more than 1mV?
NO
Defective Q8 (PLL unit).
YES
Is RF voltage at Q9 collector (PLL unit) more than 0.2V?
NO
Defective Q9 (PLL unit).
YES
Set RF Power Switch at HIGH.
Is RF voltage at Q12 collector (PLL unit) more than 0.6V?
NO
Defective Q12 (PLL unit).
YES
Is RF voltage at Q13 collector (PLL unit) more than 1V?
NO
Defective Q13 (PLL unit).
YES
Is RF voltage at D16 cathode more than 2V?
NO
Defective D16, C90, C91.
YES
Check D17 and ANT connector.
OK, but cannot resolve it.
Send the set to dealer or ICOM service center.

SCHEMA A BLOCCHI



IC-2A/AT/E SCHEMATIC DIAGRAM